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MAINTENANCE OF VOICE-FREQUENCY SIGNALING SYSTEM (VFSS) EQUIPMENT

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U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

Distribution: Selected Airway Facilities Field and Regional Offices; ZAF-600

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FOREWORD

1. PURPOSE.

a. This handbook provides guidance and prescribes technical standards and tolerances, and procedures applicable to the maintenance and inspection of voice-frequency signaling system (VFSS) equipment. It also provides information on special methods and techniques that will enable maintenance personnel to achieve optimum performance from the equipment. This information augments information available in instruction books and other handbooks, and complements the latest edition of Order 6000.15, General Maintenance Handbook for Airway Facilities.

b. This revision implements Configuration Control Decision N13656, Update Handbook Order 6650.4C Maintenance of Voice Frequency Switching (VFSS) Equipment.

2. DISTRIBUTION. This directive is distributed to selected offices and services within Washington headquarters, the FAA Technical Center, the Mike Monroney Aeronautical Center, regional Airway Facilities divisions, and Airway Facilities field offices having the following facilities/equipment: ARTCC, ATCT, TRACO, FSS, AFSS, EARTS, IFST, RAPCO, RCAG, RTR and RCO.

3. CANCELLATION.

This order cancels Order 6650.4C, Maintenance of Voice-Frequency Switching System (VFSS) Equipment.

4. MAJOR CHANGES.

This handbook has been revised to include standards and tolerances and maintenance procedures for the Intelect Type 3130A voice frequency signaling system. It also clarifies new requirements and terminology used in Technical Reference TR-TSY-000335, Voice Grade Spinal Access Service Transmission parameter limit and interface combinations. References to leased lines and other telecommunication utilities in this order have been updated to reflect the implementation of the master demarcation system (MDS) and the establishment of zero loss lines as the national standard. Numerous field comments relating to improved maintenance procedures have also been included.

5. MAINTENANCE AND MODIFICATION POLICY.

a. The latest edition of Order 6000.15, General Maintenance Handbook for Airway Facilities, this handbook, and other handbooks shall be consulted and used together by the maintenance technician in all duties and activities for the maintenance of the voice-frequency signaling system. These documents shall be used collectively as the official source of maintenance policy and direction authorized by the Operational Support Program Director. References in this handbook shall indicate to the user whether this handbook and/or the other handbooks shall be consulted for a particular standard, key inspection element or performance check, maintenance task, or maintenance procedure.

b. The latest edition of Order 6032.1, Modifications to Ground Facilities, Systems, and Equipment in the National Airspace System, contains comprehensive policy and direction concerning the development, authorization, implementation, and recording of modifications to facilities, systems, and equipment in commissioned status. It supersedes all instructions published in earlier editions of maintenance technical handbooks and related directives.

6. FORMS LISTING.

In addition to the forms required by Order 6000.15B, use FAA Form 6000-8, Technical Performance Record-Continuation or Temporary Record/Report Form, to record the performance of voice-frequency signaling equipment. The form is available under NSN 0052-00-686-0001, unit of issue: PD.

7. RECOMMENDATIONS FOR IMPROVEMENT.

Preaddressed comment sheets are provided at the back of this handbook. Users are encouraged to submit recommendations for improvement.

for Rubert E. Nobles
Acting Director, Operational Support

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CHAPTER 1. GENERAL INFORMATION AND REQUIREMENTS

1. OBJECTIVE.

This handbook provides the necessary guidance, to be used in conjunction with information available in other handbooks, for the proper maintenance of voice-frequency signaling system (VFSS) equipment.

2. AIRCRAFT ACCIDENT.

Basic aircraft accident/incident procedures on the required technical evaluations, reports, and other general procedures are contained in Order 8020.11A, Aircraft Accidents and Incidents - Notification, Investigation, and Reporting. No equipment adjustments are to be made until the as-found readings are recorded and after flight check, if required is accomplished.

3. NONSTANDARD FACILITIES.

The instructions, descriptions, standards and tolerances, and procedures contained in this directive represents the agency's baseline and standard criteria concerning VFSS equipments. Some facilities under the purview of this handbook may have been commissioned using equipment which has been procured without the benefit of agency approved specifications. Regional procurement of equipment and devices to be used for air traffic control or navigation for which specifications have not been received prior to agency approval is prohibited by Order 1100.5C, FAA Organization - Field. The inclusion of such nonstandard equipments in this order is for maintenance purposes only and as such shall not be used as justification for procurement, installation, or commissioning of additional or similar equipment.

4. COORDINATION OF MAINTENANCE ACTIVITIES.

Maintenance activities shall be coordinated with operations personnel to preclude unanticipated interruption of communication or navigational aids because of interruption of operation of associated VFSS equipment Notices to Airmen (NOTAM's), which are issued due to a malfunction of the equipment, usually fall into two categories: (1) loss of voice communications and (2) loss of monitoring. The policy regarding the issuance of a NOTAM while performing monitor maintenance is covered in Order 7930.2D, Notices to Airmen. For example, the push-to-talk (ptt) sender or receiver of the VFSS shall not be disabled or removed from service unless a NOTAM is issued showing the voice feature of the navigational aid is out for maintenance or the facility is out of service. In all cases in which facility operation may be adversely affected, sufficient advance notice shall be given so that appropriate NOTAM's can be issued. The information necessary for the preparation of such NOTAM's shall be furnished promptly. Operations personnel should cooperate in releasing equipment for scheduled routine maintenance to assure its continuous and reliable operation.

5. CONVERSION TO ZERO LOSS LINES.

a. Zero Loss Lines (ZL^2) are characterized as leased telephone company (telco) circuits with 0-dB nominal loss at 1000 Hz. FAA policy requires the installation of ZL^2 as the national standard for all future leased telco circuits. This order will continue to support non-ZL^2 until transition to the national standard has been completed.

b. The Zero Transmission Level Point (Ø TLP) is the point in a communication circuit to which all relative levels at other points in the circuit are referred. A 1000-Hz, 0-dBm, test tone will be established as the nominal alignment signal power level at the Ø TLP. To the extent possible the Ø TLP will be established at the master demarcation system (MDS).

6.-19. RESERVED.

CHAPTER 2. TECHNICAL CHARACTERISTICS

20. PURPOSE OR FUNCTION.

The voice-frequency signaling system (VFSS) equipment provides remote control of communications or navigational aids (navaids) equipment installed at a facility that is remotely located from the air route traffic control center (ARTCC), airport traffic control tower (ATCT), flight service station (FSS), or the automated flight service station (AFSS). Figure 2-1 provides a summary of typical VFSS uses. The radio control equipment may include one or more tone channels on the reverse path to monitor the status of a remote facility.

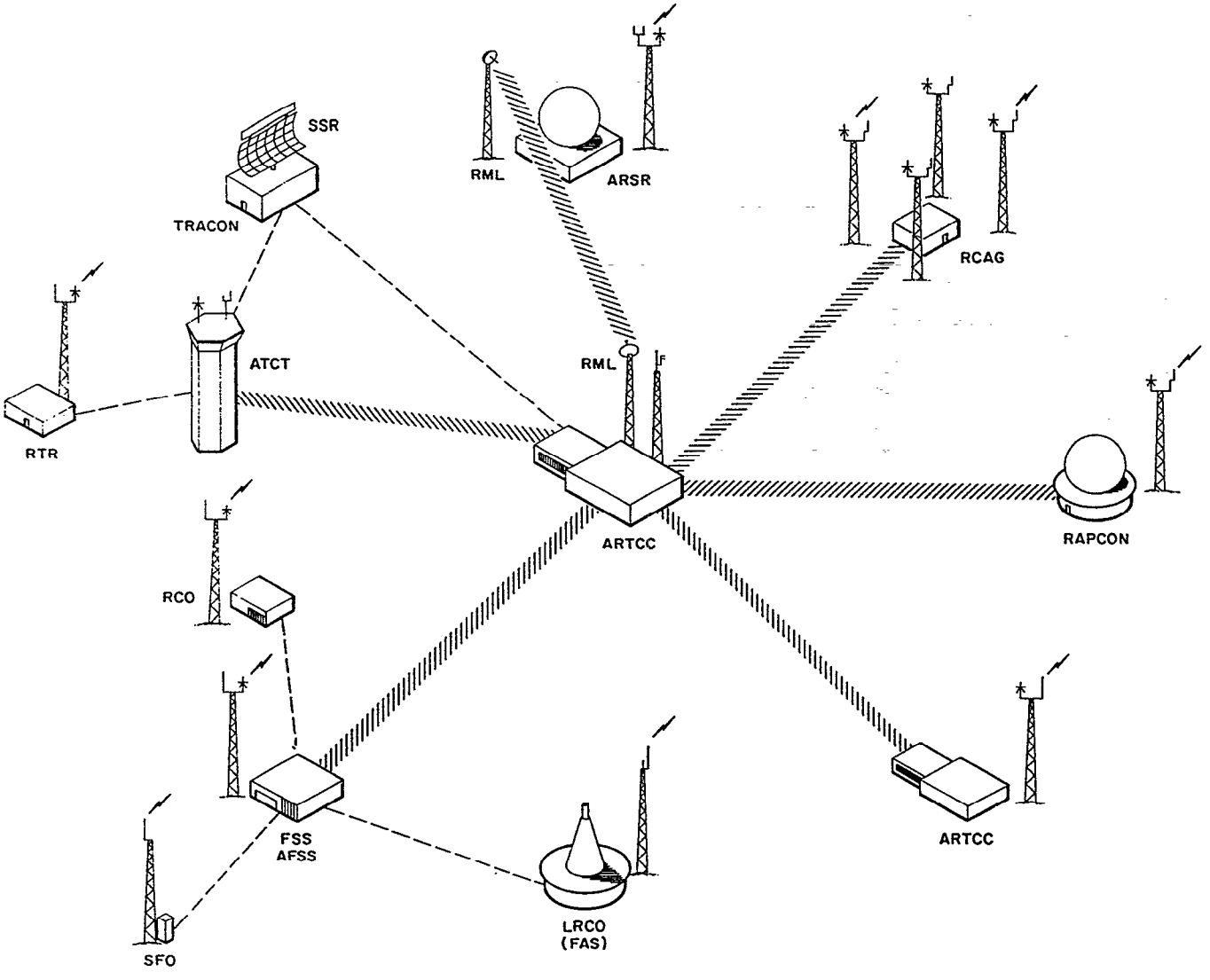


Figure 2-1. ATC A/G Radio Communications Network

21. GENERAL DESCRIPTION.

a. Voice frequency signaling system (VFSS) equipment is classified into six categories when system types are considered. The six categories are (1) Tone Channeling, (2) Tone Control, (3) Tone/Scan, (4) Carrier Signaling, (5) Data Above Voice, and (6) In-band Single Frequency. Table 2-1 provides a listing of equipment models in each system type. The systems listed use several discrete audio frequencies transmitted over a telecommunications utility (FAA owned lines, FAA leased lines, RCL, etc.). Past installations included a requirement for service type 3 (Specification FAA-S-1142a) and service type 5 grade (2002,3002) lines, but zero loss voice grade lines with a zero transmission level (Ø TLP) have now been established as the national standard.

Table 2-1. FAA VFSS EQUIPMENT

TONE CHANNELING	*DATA ABOVE VOICE*
B5, D103, D104 CA-1621 CA-1708 FA-5390 FA-8187 FA-8735 [1] VFSC-6/VFRC-6 [1,2]	3130A [1] LCT-CNTR-( ), RCT-RCAG-( ) LCT-CNTR-1A, RCT-RCAG-1A [1] RCC-FSS-8/1(R), RCC-RCO-8/2(R) RCC-FSS-8/1(RCAG), RCC-RCO-8/8(RCAG) RCC-FSS-8/1(SFO), RCC-FSS-8/8(SFO)
TONE CONTROL	*CARRIER SIGNALING*
CA-1668 FA-5250 FA-5531 FA-5652 [1] VFSS-ST/VFSS-RT [1]	CA-1703 CA-1709
TONE SCAN	*IN-BAND SINGLE FREQUENCY*
FA-5555-70 [1] FA-5650 [1]	310, 312, 341, 345 [1]

[1] Solid State
[2] Interchangeable with FA-8735

b. Zero loss, Ø TLP lines are basic 2-point nonconditioned, dedicated voice grade telephone circuits which have improved signal transmission characteristics and are characterized by a relatively flat frequency response with low noise over the nominal frequency range of 300 to 3000 Hz. The attenuation at 1000 Hz is 0 dB. FAA specifications require that the lines exhibit a 600-ohm impedance. Circuit type VG6 is furnished for voice and data applications up to 9600 bits per second (bps). Circuit type VG8 is furnished for data applications above 9600 bps. Standards and tolerances, periodic schedules, and maintenance procedures for voice-grade lines are found in Order 6000.22, Maintenance of Analog Lines. FAA policy requires installation of zero loss lines at Ø TLP for all future leased telephone circuits in accordance with the

new standard. This order will continue to support other existing line types until transition to the national standard has been completed.

c. The master demarcation system (MDS) is the physical point of separation between internal Air Route Traffic Control Center (ARTCC) FAA equipment and the transmission utility (leased lines, RCL, etc.). For most equipment in the center, the MDS is designated as the Ø TLP. The MDS consists of wiring frames and jackfields designed to provide a centralized location for circuit patching, circuit testing, and trouble isolation. Normal operating signal levels at the MDS (Ø TLP) should not exceed −13 dBm average over a continuous 3 second interval. Four wire telco circuits at the MDS should be established as the end state configuration of zero loss, Ø TLP lines.

d. Tone channeling systems typically use six voice frequency (vf) tones to provide control of radio communications equipment at remote locations. One tone channeling system can provide control of one ATC communications channel. This system controls very high frequency (vhf) or ultra high frequency (uhf) channel selection, main or standby transmitter and receiver selection, receiver muting, and transmitter push-to-talk (PTT) for remote site equipment. One of the six tones used is a frequency shift (fs) tone and present all the time, the others are audio mode (am) and present only part of the time. There are no provisions for status monitoring of remote site equipment. System telephone circuits are shared by control tones, transmitter speech, and receiver audio signals.

e. Tone control systems typically use five vf tones to provide control and status monitoring for very high frequency omnirange (VOR) and tactical air navigation (TACAN) equipment (VORTAC facilities) at remote locations. The lowest two tone frequencies provide PTT and dialing control signals for remote site equipment. The highest three tone frequencies provide status monitor indications to the control site. This system typically uses the VOR transmitter speech modulation feature for transmissions, and the VORTAC flight advisory service (FAS) receivers for reception when communicating with an aircraft. Transmitter speech signals and the dialing control tone cannot be on the telephone line at the same time. Telephone circuits in this system are shared by control tones, status monitor tones, transmitter speech, and receiver audio.

f. Tone/scan systems use twenty vf tones to accomplish control and status monitoring of remote site equipment. Ten am tones provide PTT control signals to remote site equipment. One FS tone provides dialing control of remote site equipment. Another FS tone is used as the carrier for a data word that provides mute and squelch control signals for remote site equipment. (The data word can provide control of 16 separate functions.) The remaining eight am tones are used to provide status monitor reporting to the control site. This system does not share telephone circuits with transmitter speech or receiver audio signals.

g. Carrier signaling systems also use twenty vf tones to accomplish control and status monitoring of remote site equipment. Fourteen am tones are used to provide control signals to the remote site equipment. The remaining six am tones are used to provide status monitoring signals to the control site equipment. This system does not share telephone circuits with transmitter speech or receiver audio signals.

h. Data above voice systems use a fs tone at the control site to provide control of remote site equipment. In most data above voice systems, the tone from the control site is the carrier for a twelve bit asynchronous data word that provides control signals for eight units of remote site equipment. The data word is transmitted serially at 150 bits per second. Another fs tone on the return link provides status monitor reporting to the control site. The data word contains eight status bits for the status monitor at the control site. The data above voice single frequency outlet (SFO) system provides one control signal for the remote equipment and no status monitor reporting for the control site. Control signals and status signals share system telephone circuits with transmitter speech and receiver audio signals in these systems.

i. In-band single frequency systems use a single am tone from the control site to provide control of remote site equipment. No status monitor functions are provided. Transmitter speech and receiver audio signals share system telephone circuits with the control signal.

22. TONE CHANNELING VFSS.

a. Tone channeling VFSS equipment provides the telephone circuit interface required for control of a remotely located ATC communications channel. Equipment such as CA-1621, CA-1708, FA-5390, FA-8187, FA-8735, as well as B5, D103, D104 by LYNCH, and VFSC-6/VFRC-6 by GRM typify this system. A tone channeling VFSS is shown in figure 2-2. Six tone senders are available, one frequency shift (fs) and 5 audio mode (am). The 2805-Hz fs sender is used to provide remote site equipment with conditioning signals prior to any control activities. The 1615-Hz am tone is used to provide muting of the remote VHF receiver when that is desired. The 1275-Hz am tone provides muting for the remote UHF receiver. The 935-Hz tone is used for main or standby equipment selection at the remote site. PTT for the VHF transmitter is accomplished using the 1955-Hz am tone. PTT for the UHF transmitter is provided with the 595-Hz am tone.

b. Because tone channeling VFSS equipment can only generate and detect tones, a control system interface unit is required. Voice Frequency Control Systems provide the required interface between the VFSS and ATC communication equipment. Voice Frequency Control Systems such as the CA-1620, CA-3446, FA-5397, FA-5651, FA-8048, FA-8717, and VFCS/GRM are commonly used with VFSS equipment. At the control site VFCS equipment provides tone selection, timing and pulse control of the VFSS in response to operator manipulation of control switches at the operating position. At the remote site, VFCS equipment provides control of radio equipment in the manner dictated by VFSS equipment output signals. Transmitter speech and receiver audio share telephone circuits with this system.

c. The Idle State. A typical tone channeling VFSS/VFCS system is shown in figure 2-3. As long as no control function is being performed, the system will be in the idle state, the fs sender at 2847.5 Hz, am senders disabled, am receivers disabled, no remote transmitter keyed, and remote VHF/UHF receiver audio available on the telephone circuits and at the control position.

d. The Push To Talk (PTT) Function. When the operator presses the PTT switch, the fs sender will downshift to 2762.5 Hz, the dual channel amplifier will be disconnected from the telephone circuits, the 1955-Hz sender will output a tone burst (VHF selected) or the 595-Hz sender will output a tone burst (UHF selected), and the microphone regulated output amplifier will be connected to the telephone circuits. At the remote site the FS tone downshift will cause the VHF and UHF receivers to be muted, the AM tone receivers to be enabled, and the regulated output amplifier input to be connected to the telephone circuits. The 1955- or 595-Hz tone burst will cause the selected channel transmitter to be keyed, and it will remain keyed until the operator is through and releases the PTT switch. At that time, the system will return to the idle state, and receiver audio will be available on the telephone circuits and at the operator position.

e. Main/Standby Selection. Each time the operator makes a main or standby equipment selection and the system is idle, an equipment change will result. At the control site when a selection is made, the fs sender will downshift to 2762.5 Hz, the dual channel amplifier will be disabled, and the pulse generator will cause the 935-Hz sender to output a series of pulses. (The number of pulses is related to the equipment selected.) At the remote site, when the fs receiver detects the downshift, the VHF and UHF receiver outputs will be disabled, and the am receivers will be enabled. When it is present, the 935-Hz pulse train will be decoded, and the desired equipment selected. When the selection is complete, the system will return to the idle state.

f. Receiver Muting. When the operator presses the VHF mute or UHF mute switch, the corresponding receiver will be muted, and remain that way until the switch is released. At the control site, pressing the switch causes the FS sender to downshift, and the 1615-Hz (VHF mute) or 1275-Hz (UHF mute) sender to operate. At the remote site, the FS tone downshift enables the AM receivers. The 1615-Hz or 1275-Hz tone causes the matching AM receiver to mute the selected receiver. When the operator releases the mute switch, the system will return to the idle state once more.

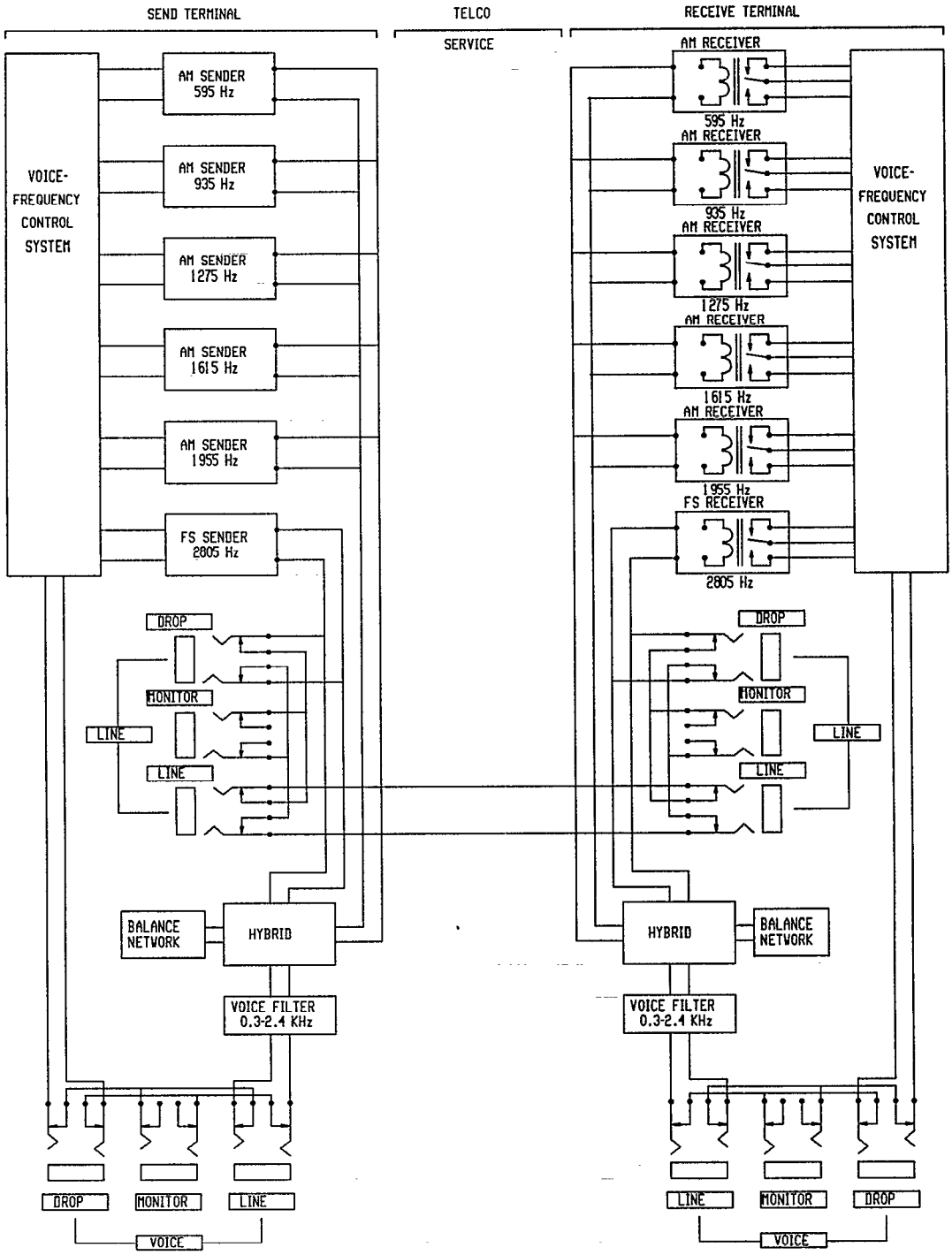


Figure 2-2. Tone Channeling VFSS

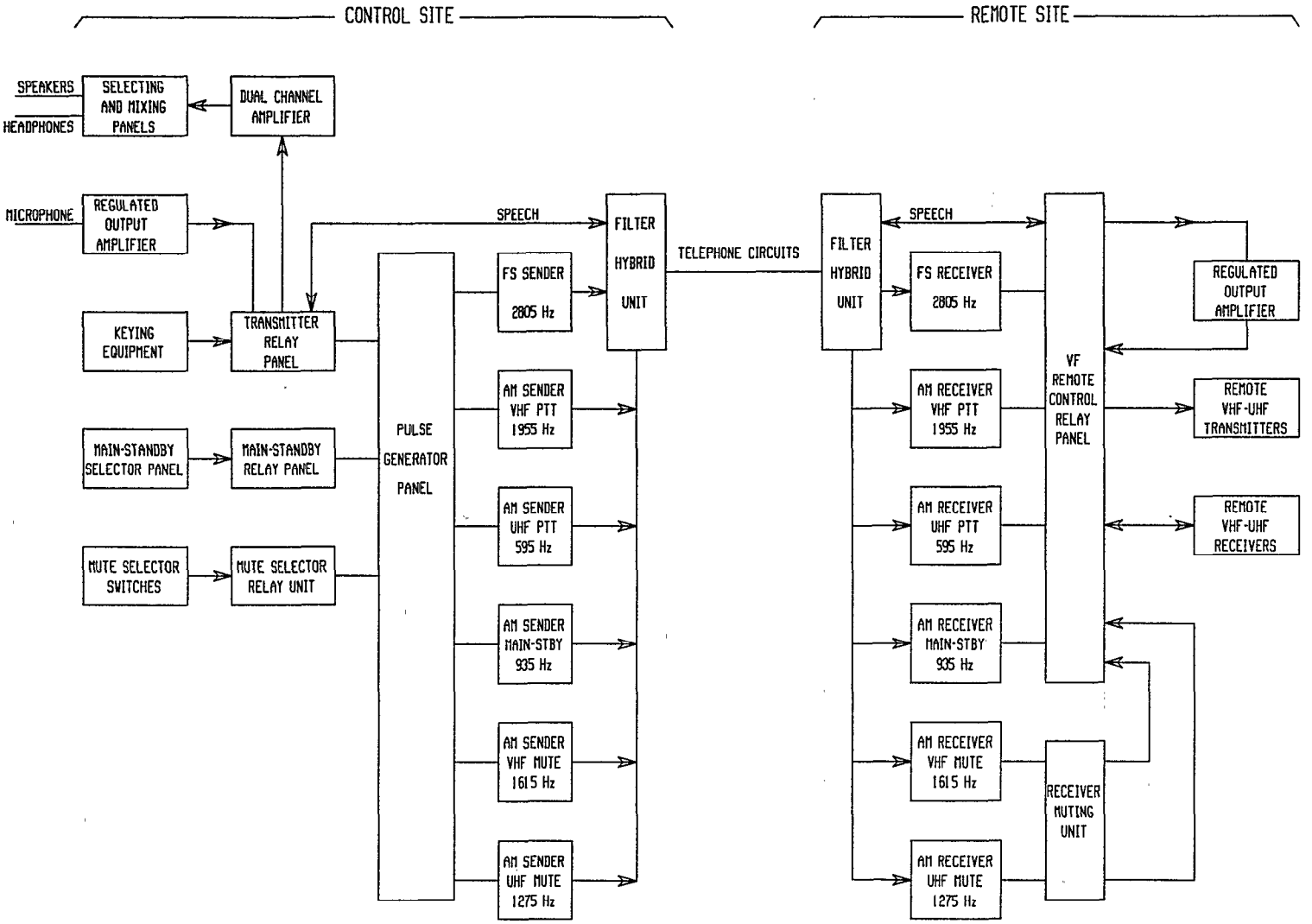


Figure 2-3. Tone Channeling VFSS/VFCS

23. TONE CONTROL VFSS.

a. Tone control VFSS equipment provides the required interface between control site equipment, telephone circuits, and remote site VOR/TACAN equipment. Equipment such as the CA-1668, FA-5250, FA-5531, FA-5652, and VFSS-ST/VFSS-RT typify this system. This system does not require a control system interface.

b. A typical tone control VFSS is shown in simplified form in figure 2-4. It uses two am tones for control purposes, and three am tones for monitor purposes. The control tones are 540 Hz for remote dialing control, and 2580 Hz for PTT control. The three additional tones used on the return telephone link are 2700 Hz for VOR status monitoring, plus 2820 Hz and 2940 Hz for TACAN status monitoring. Transmitter speech and receiver audio share telephone circuits with this system.

c. **The Idle State.** As long as control functions are not being performed, audio output from the Flight Advisory Service (FAS) receivers is available at the control site speaker. If the VOR ident monitor feature is on, then the VOR ident signal will also be available at the control site speaker.

d. **Dialing Function.** Whenever the operator presses the dialing key on the dialing unit and dials one of the function codes shown in table 2-2, the 540-Hz sender will output a matching code train. At the remote site, the 540-Hz receiver will detect the code train and provide the remote dialing control unit with control signals that will initiate the desired equipment changes.

e. **Push To Talk Function.** When the PTT switch is pressed at the control site, the 2580-Hz sender is enabled, the 540-Hz sender is disabled, and the control site voice unit is connected to the telephone circuits. At the remote site, the 2580-Hz receiver will detect the tone and disable the 540-Hz receiver, enable the transmitter voice circuit, and allow the operator to communicate with the aircraft using the VOR transmitter voice feature.

f. **VOR Monitor Function.** As long as the remote site VOR equipment is operating in a satisfactory manner, the 2700-Hz sender will provide tone to the control site over the return telephone link. At the control site, the 2700-Hz am receiver will keep the VOR monitor unit providing an operational indication. When the 2700-Hz tone is missing, the control site monitor will give an alarm indication.

g. **TACAN Monitor Function.** If at least one of the TACAN equipments is operational, one of the two tone senders will also be operational and will provide the control site TACAN monitor with an operational indication for that equipment. When both TACAN equipments have failed, both senders will be disabled, and the control site monitor will give an alarm indication. In some systems, the senders and receivers are part of the TACAN equipment.

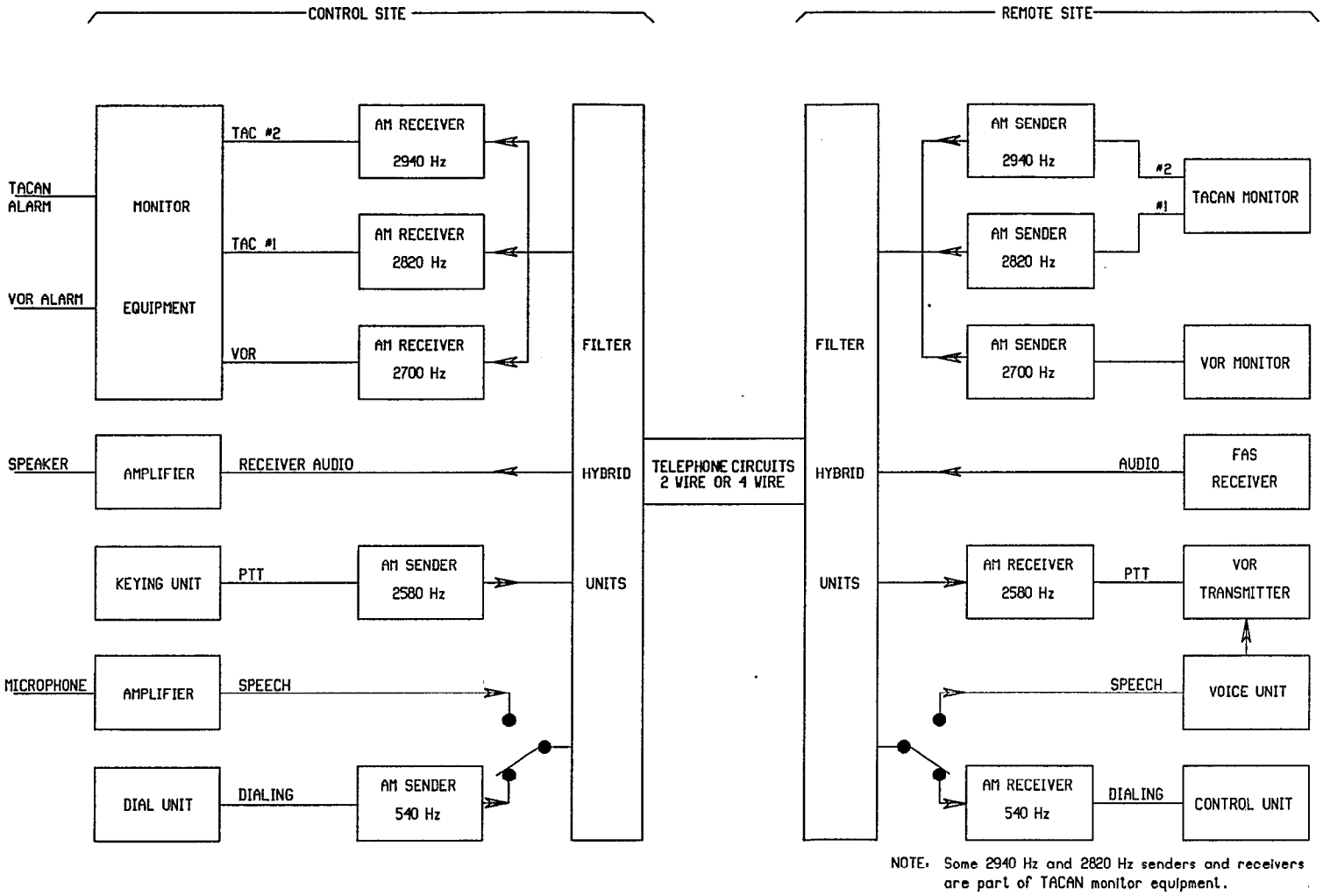


Figure 2-4. Tone Control VFSS

Table 2-2. DIAL FUNCTIONS

REMOTE CONTROL FUNCTIONS	*SEQUENTIAL CODES*	
FUNCTION	ON	OFF
BUZZER	00 [1]	00 [2]
MASTER CONTROL	04	06
ATU RESET	04	
VOICE	11	21
FAS RECEIVER NO. 1	13	14
FAS RECEIVER NO. 2	14	13
TACAN FILAMENT NO. 1	23	24
VOR FILAMENT NO. 1	28	29
TACAN FILAMENT NO. 2	33	34
VOR FILAMENT NO. 2	38	39
VOR PLATE NO. 1	41	42
VOR PLATE NO. 2	42	41
VOICE-OPERATED RELAY	45	46
TACAN HIGH VOLTAGE NO. 1	51	52
TACAN HIGH VOLTAGE NO. 2	52	51
VOR ALARM TEST	67 [1]	
VOR IDENT. MONITOR	68	69
DME TRANSFER RESET	72	
TACAN STATUS RESET	73	
VOR ONLY-MONITOR	75	
VOR/DME-MONITOR BOTH	77	
DME MAIN POWER NO. 1	78	79
DME HIGH VOLTAGE NO. 1	81	82
DME HIGH VOLTAGE NO. 2	82	81
DME MAIN POWER NO. 2	88	89
LINK RECEIVER TRANSFER	90	
OBSTRUCTION LIGHTS	91	92
VORTAC CONTROL-NORMAL	94	
VORTAC ON TACAN CONTROL LINE	95	
VORTAC ON VOR CONTROL LINE	96	

[1] Hold Key
[2] Release Key

24. RECEIVER CHANGEOVER AND HYBRID PANEL.

The receiver changeover and hybrid panel is used at VOR/VORTAC facilities that have flight advisory service (FAS) receivers. These receivers were formerly called limited remote communications outlets (LRCO). The purpose of the panel is to isolate the 540-Hz tone channel from the FAS receiver/monitor circuit while providing main/standby switching of FAS receiver audio output and antenna input. It also allows for the removal of the receiver/monitor VOR ident circuit from the line during voice transmission. A variable attenuator pad is provided for adjustment of the VOR monitor signal. A hybrid transformer isolates the necessary circuits. Nine jacks are provided allowing bridge drop-line interfacing for the LINE, TONE, and RCVR/AMP sides of the hybrid. The FAA uses two types of this panel - the FA-5279 and the FA-5469 - which operate identically.

25. CARRIER SIGNALING VFSS.

a. Carrier signaling VFSS equipment provides the telephone circuit interface required for control of remotely located ATC communications channels. The CA-1703, and CA-1709 typify this system. Twenty discrete AM tones are used to accomplish control and monitoring of remote site equipment. Transmitter speech and receiver audio do not share telephone circuits with this system, they require separate telephone circuits. A simplified diagram of this system is shown in figure 2-5.

b. Voice frequency control systems such as the CA-1799 and FA-5653 provide the required interface between the carrier signaling VFSS and control site ATC radio equipment. At the control site VFCS equipment provides selection and control of the VFSS tones in response to operator manipulation of control switches at an operating position. At the remote site, VFSS equipment controls the radio equipment in the manner dictated by the tones it receives.

c. **Control Functions.** There are three control functions available in this system. They are PTT, mute, and dialing. Each of them will provide a contact operation at the remote site whenever the control site operator uses a PTT switch, mute switch, or dial control. A total of fourteen am senders are available for this purpose. Their frequencies start at 300-Hz and continue in 120-Hz increments to 1860 Hz. Dialing control utilizes the 1860-Hz sender. The remaining thirteen tone senders can be used for various combinations of PTT and Mute control. Due to VFCS equipment limitations, up to nine transmitters can be keyed, or up to seven receivers can be muted. The total of the two cannot exceed thirteen however, since only that many senders are available in the VFSS. At the remote site, the fourteen matching am receivers are available to decode incoming tones and provide the desired dial control or PTT or muting of selected remote equipment.

d. **The Monitor Function.** The monitor function provides remote status information to the control site. Status monitoring uses six am senders at the remote site. Their frequencies start at 2100 Hz and continue to 2700 Hz in 120-Hz increments. Six matching am receivers are available at the control site to accomplish the required decoding and monitor control functions. Outputs from remote site monitors will be displayed on indicators at the control site.

26. TONE/SCAN VFSS.

a. Tone/scan VFSS equipment also provides the interface required between control site equipment, telephone circuits, and remote site radio equipment. Equipments such as the FA-5555-70, and FA-5650 typify this system.

b. The tone/scan VFSS system uses eighteen separate am tones to control and monitor remote site equipment. Squelch and mute controls at the control site are continuously scanned and their condition used to control equipment at the remote site. A dialing channel is available for remote site equipment control. Both the dialing and scanning channels use fs tones as carriers to the remote site. Transmitter speech and receiver audio do not share telephone circuits with this system, they require separate telephone circuits. A simplified diagram of this system is provided in figure 2-6.

c. **Push To Talk Function.** The push to talk function allows an operator at the control site to key a selected transmitter at the remote site with the PTT switch at the operator position. Ten am senders at the

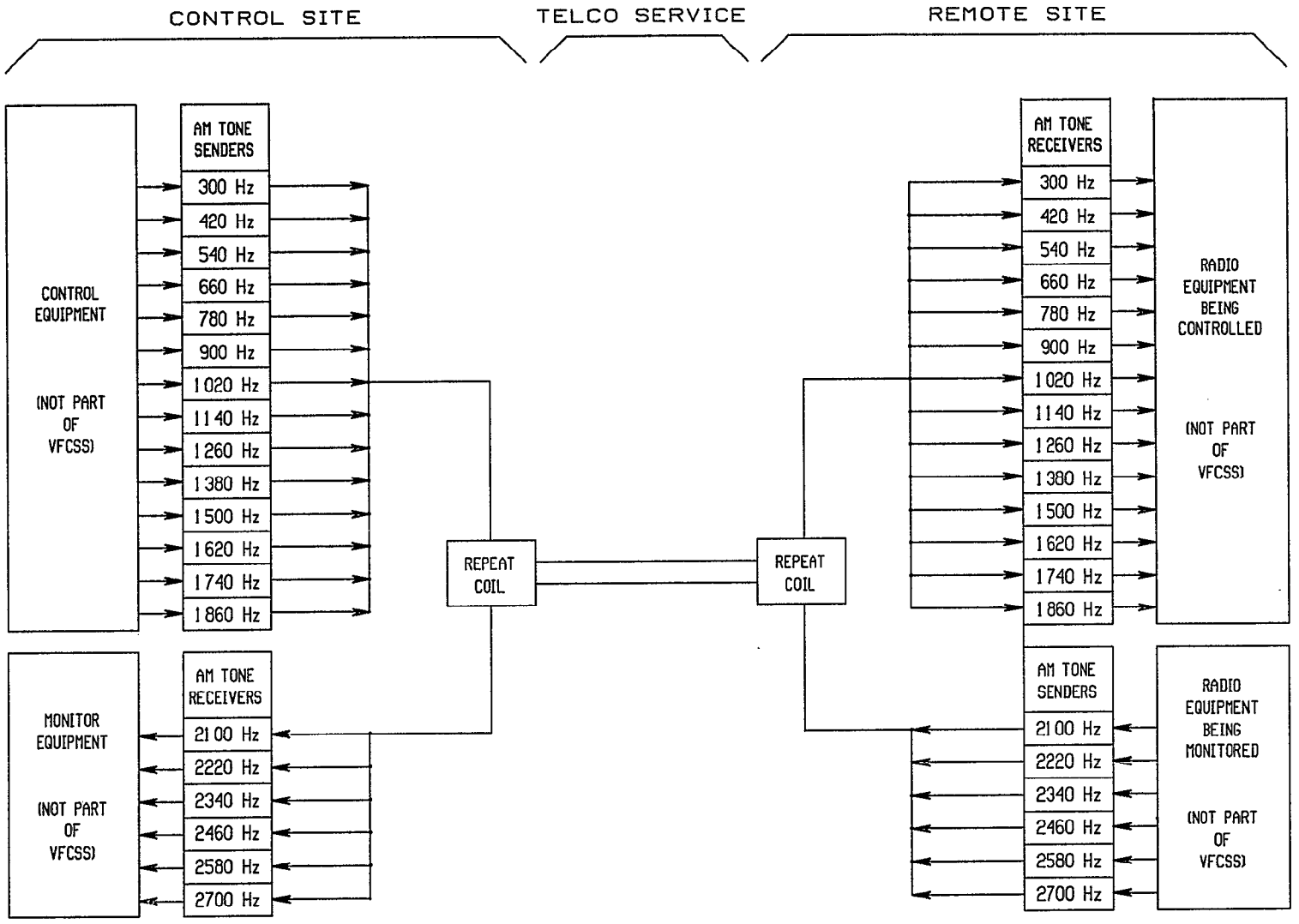


Figure 2-5. Carrier Signaling VFSS

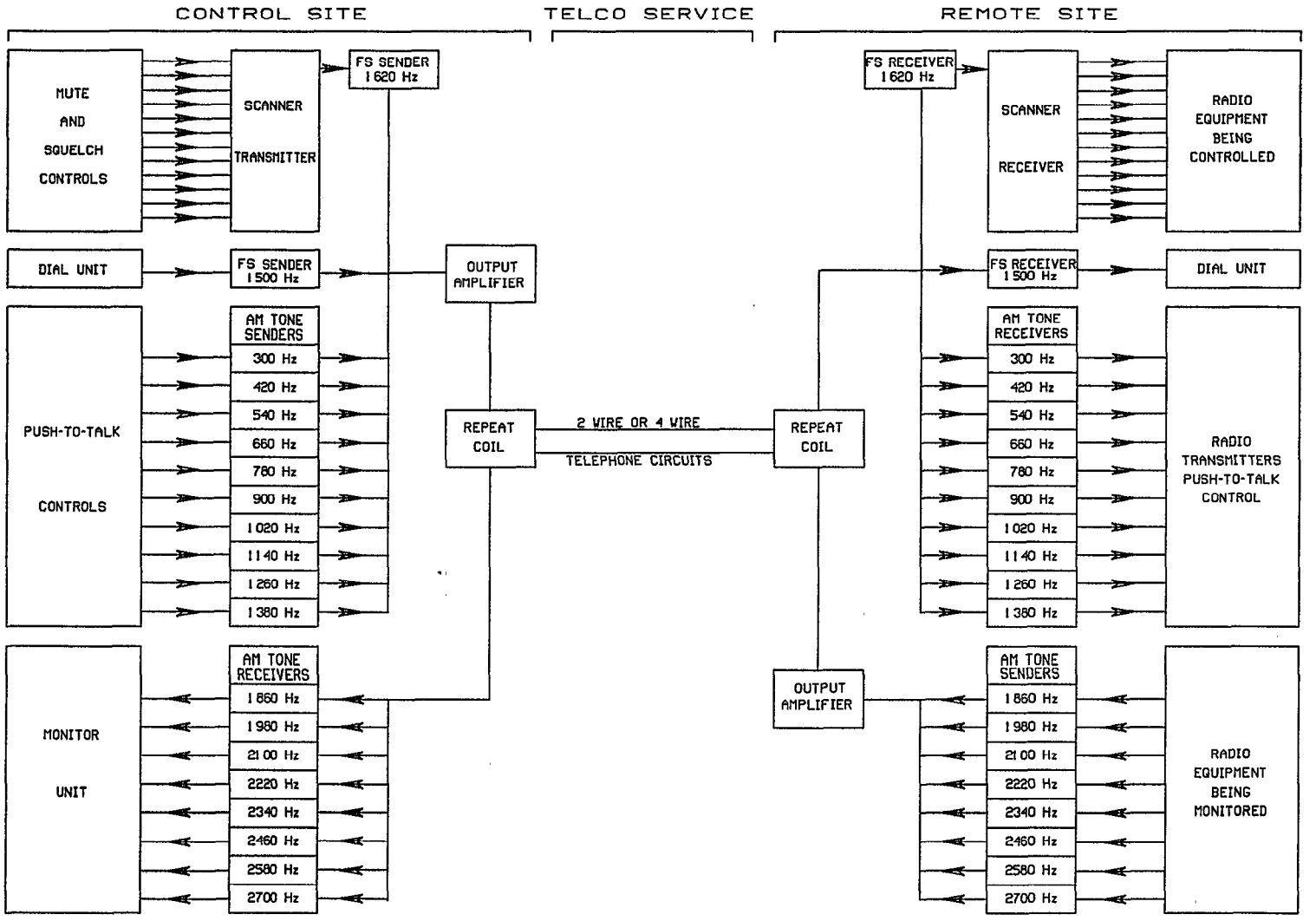


Figure 2-6. Tone/Scan VFSS

control site are used for PTT control. Their frequencies start at 300 Hz and continue to 1380 Hz in 120-Hz increments. Ten matching am receivers at the remote site decode the tone and provide control of the selected remote radio transmitter.

d. Monitor Function. The monitor function provides status information from the remote site to the control site. Status monitoring uses eight am tone senders at the remote site. Their frequencies start at 1860 Hz and continue in 120-Hz increments to 2700 Hz. Eight matching am receivers at the control site control the monitor equipment.

e. Dialing Function. The dialing function allows a control site operator using the rotary dial unit, to control equipment at the remote site. The dial unit controls the output frequency of a 1500-Hz fs sender at the control site. A matching fs receiver at the remote site decodes the tones and provides an output suitable for dialing control of remote site equipment.

f. Scan Function. The scan function automatically scans mute and squelch controls at the control site and transmits their status to the remote site to be used for equipment control. The scan transmitter samples control status every 1.8 seconds and transmits status information to the remote site in a low speed binary data signal. It provides an output signal pulse train that contains 16 data bits, a 15 bit stop pulse, and two framing pulses. The output pulse train provides asynchronous control of the scan receiver at the remote site. A 1620-Hz fs tone channel is used between the transmitter and receiver. The scanner receiver decodes the pulse train and operates switching contacts that provide remote site equipment control in accordance with the data in the pulse train.

27. IN-BAND SINGLE FREQUENCY VFSS.

a. In-band single frequency VFSS equipment provides the telephone circuit interface required for PTT control of one remote transmitter. A typical in-band single frequency VFSS uses the commercial Vega in-band tone signaling equipment. In-band single frequency equipment furnished by the telephone company is similar.

b. A Vega system is shown in figure 2-7. The control site uses a single tone encoder model 310 to generate the tone required for PTT control and a model 312 amplifier to supply voice and control tone signals to the telephone circuits. The remote site uses a model 345-bandpass/notch filter to separate voice signals from the control tone. A model 341 tone decoder is used to detect the control tone and key the transmitter.

28. DATA ABOVE VOICE VFSS.

a. Data above voice VFSS equipment also provides the telephone circuit interface required for control of remotely located ATC communications channels. There are two types of data above voice systems currently in use. One (complete system) provides control and monitoring of one complete ATC communications channel, the other (limited system) provides control of from 1 to 4 transmitters and provides no status monitoring. Equipments such as LCT-CNTR-( )/ RCT-RCAG-( ); RCC-FSS-8/1 (RCAG) / RCC-RCO-8/8 (RCAG); and the Intelect 3130A typify the complete system. The RCC-FSS-8/1 (SFO) / RCC-FSS-8/8 (SFO) typifies the limited system.

b. A complete system simplified diagram is shown in figure 2-8. At the control site one fs sender operating in the 2800 to 3000-Hz frequency band provides the carrier for all control information to the remote site. At the remote site, a receiver decodes the control information and provides the required equipment control functions. Another fs sender at the remote site provides the carrier for all status information to the control site. At the control site, a receiver decodes the status information and provides signals to the monitor to display as remote site equipment status. Control signals and status signals are transmitted on their respective carriers in asynchronous 12 bit words. Because there are 8 data bits to each data word, 8 control items as well as 8 status items are managed in this system.

c. One limited system simplified diagram is shown in figure 2-9A. At the control site one fs sender operating in the 2800 to 3000-Hz frequency band provides the carrier for PTT control of one transmitter at one remote site. Other control locations use more than one limited system to provide control of one

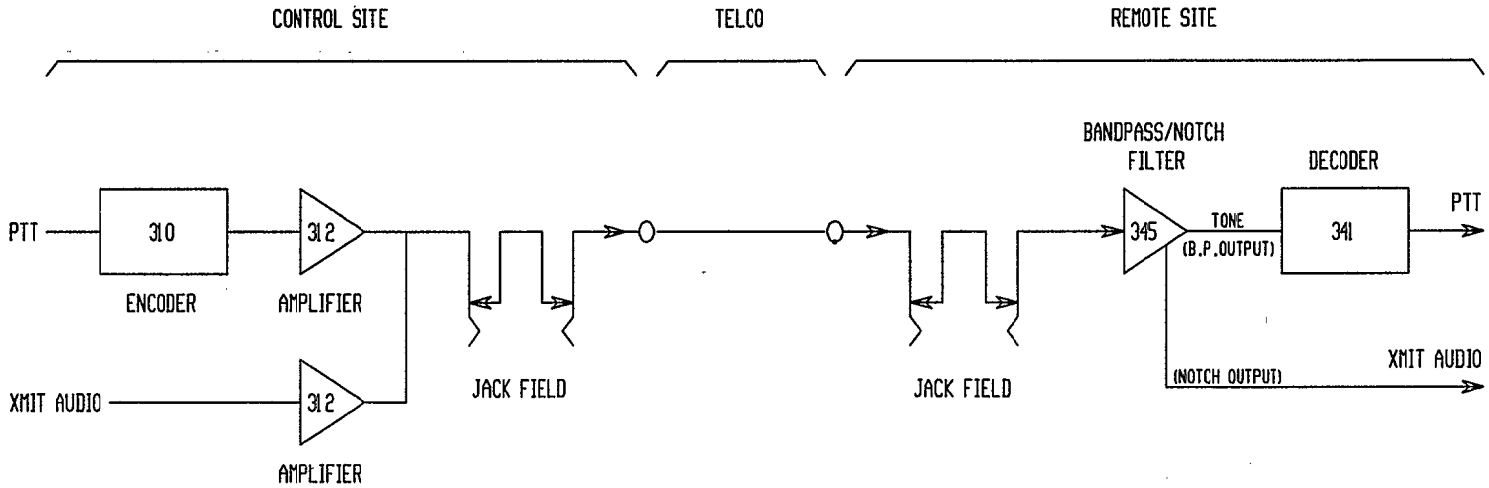


Figure 2-7. In-Band Single Frequency VFSS

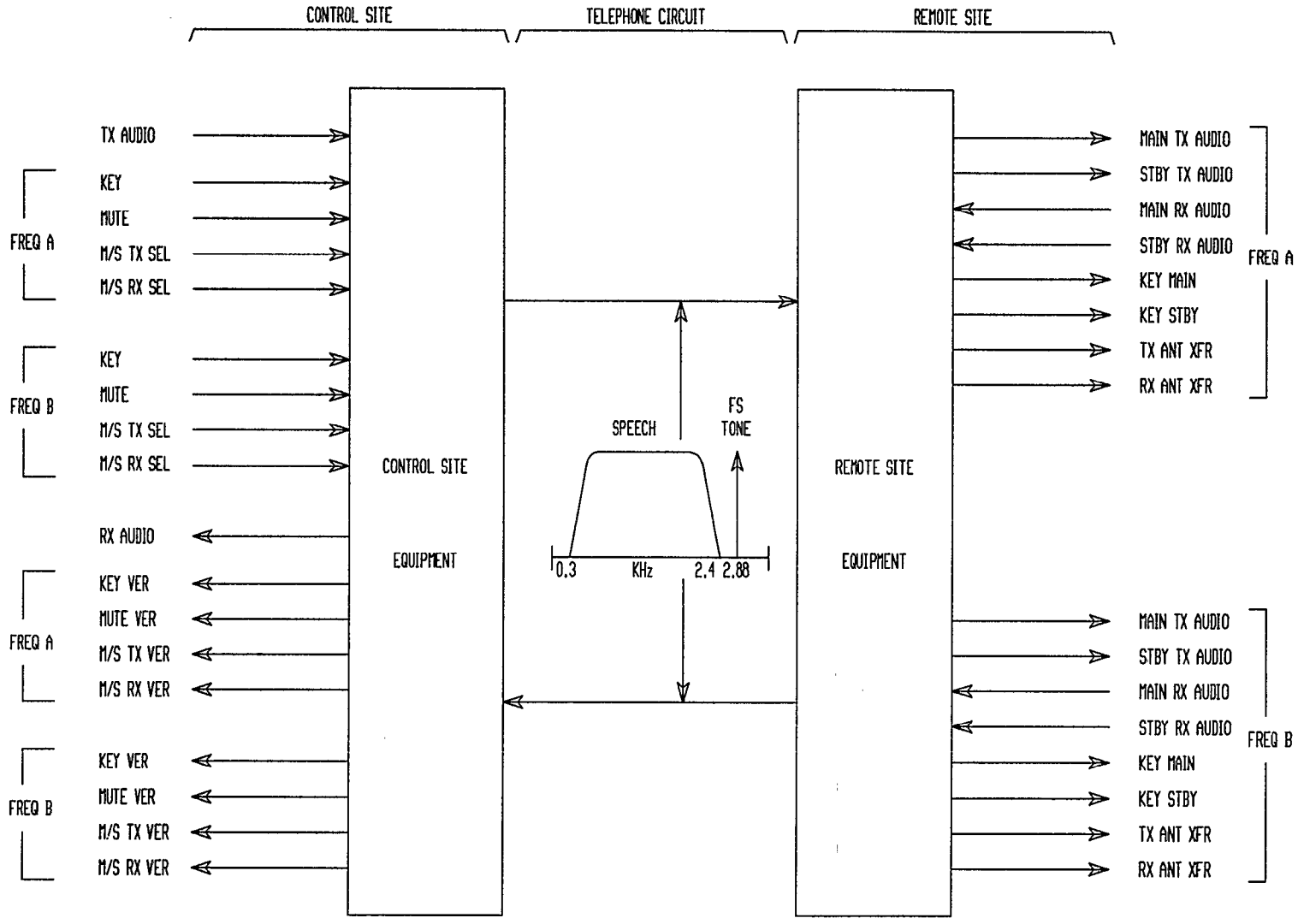


Figure 2-8. Data Above Voice VFSS

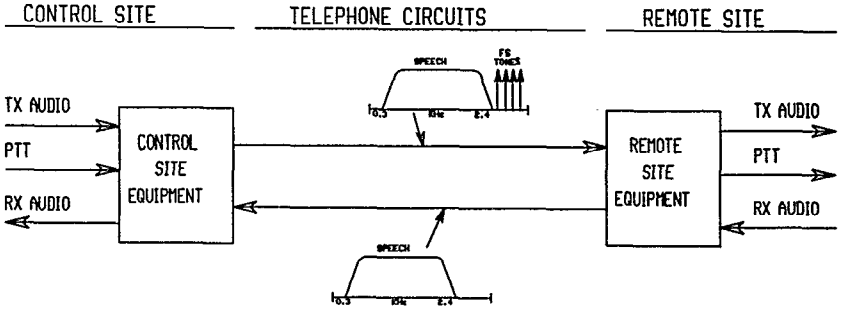


Figure 2-9A.

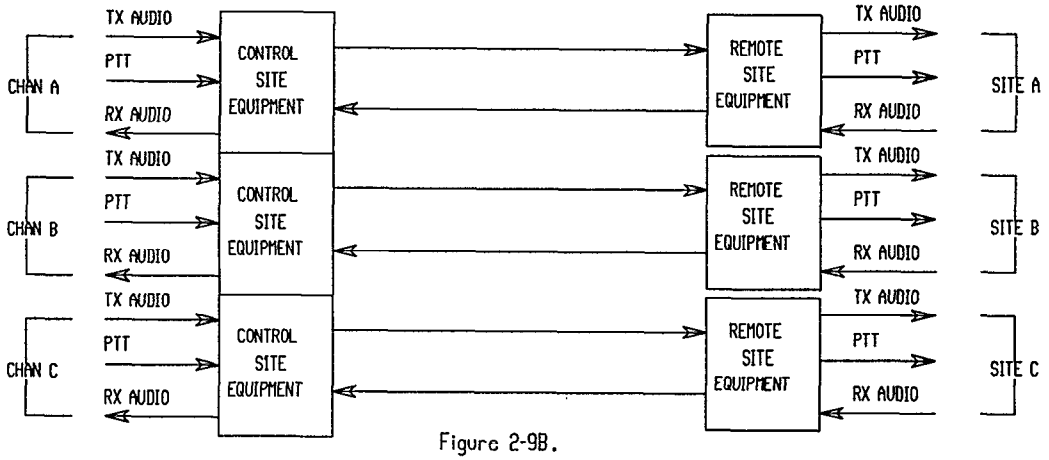


Figure 2-9B.

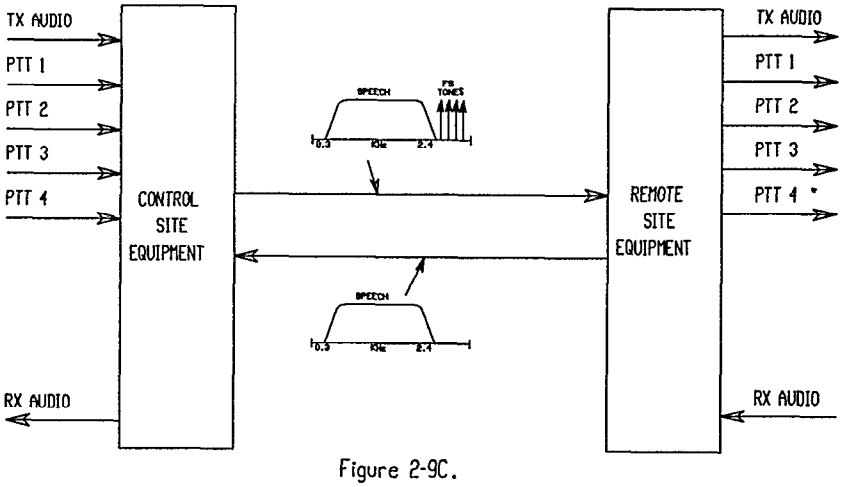


Figure 2-9C.

Figure 2-9. Data Above Voice (SFO) VFSS

transmitter at each of several separate remote locations (figure 2-9B). Still other control locations use a limited system with more than one fs tone channel to control one of several transmitters at one remote site location (figure 2-9C). There are no provisions for status monitoring in any of the limited systems.

d. In all data above voice systems, operator speech and receiver audio signals traverse the same telephone circuits as control and status signals. They are confined to the 300 to 2400-Hz frequency spectrum below the status and control tone channels. The systems require no interface units, and work directly with existing equipment, providing a switch contact closure at the remote site output for a switch contact closure at the control site.

* **29. RADIO CONTROL EQUIPMENT (RCE).**

a. The Communication Systems Technology Incorporated (CSTI) CS-2330 radio control equipment (RCE) provides the telephone circuit interface required for control of remotely located ATC communications channels. The RCE, as configured for the National Airspace System (NAS) environment will support up to two frequency channels through the use of a data voice card (DVC) enclosed in a dual channel enclosure. The DVC represents the heart of the RCE and uses digital signal processor technology to process audio signals and encode control data for transmission via a high performance modem. One complete system provides control and monitoring of two ATC communications channels.

b. Each RCE system is complemented by a set of * centralized and automated system monitoring and control equipment. The maintenance data terminal (MDT) provides workstation monitoring of a single RCE channel. A channel includes the communication equipment associated with one control site to remote site communication link. The centralized maintenance system (CMS) is located at the control site and provides work-station monitoring of multiple RCE channels. The CMS includes a centralized maintenance terminal (CMT) which provides the primary user interface and one or more communication servers. Each server directly monitors a subset of RCE channels by continuously polling the RCE hardware. The CMS can monitor up to 1000 RCE channels.

c. A complete system simplified diagram is shown in figure 2-10. The CMS and MDT components are optional, as indicated by the dotted lines. The optional backup telco trunk is also shown as a dotted line. The RCE accepts both audio and radio control information. The telco interface is a four-wire leased transmission line, however it will work over satellite and microwave transmission paths.

d. The RCE assemblies for the control and remote sites are configured differently. The control site RCE components are labeled C-RCE and the remote site RCE components are labeled R-RCE. For example, the C-RCE equipment includes a power factor corrected ac/dc power supply. The R-RCE includes a commercial power supply, but includes an additional dc/dc converter for site dc power conditioning.

* **30.-59. RESERVED.** *

*

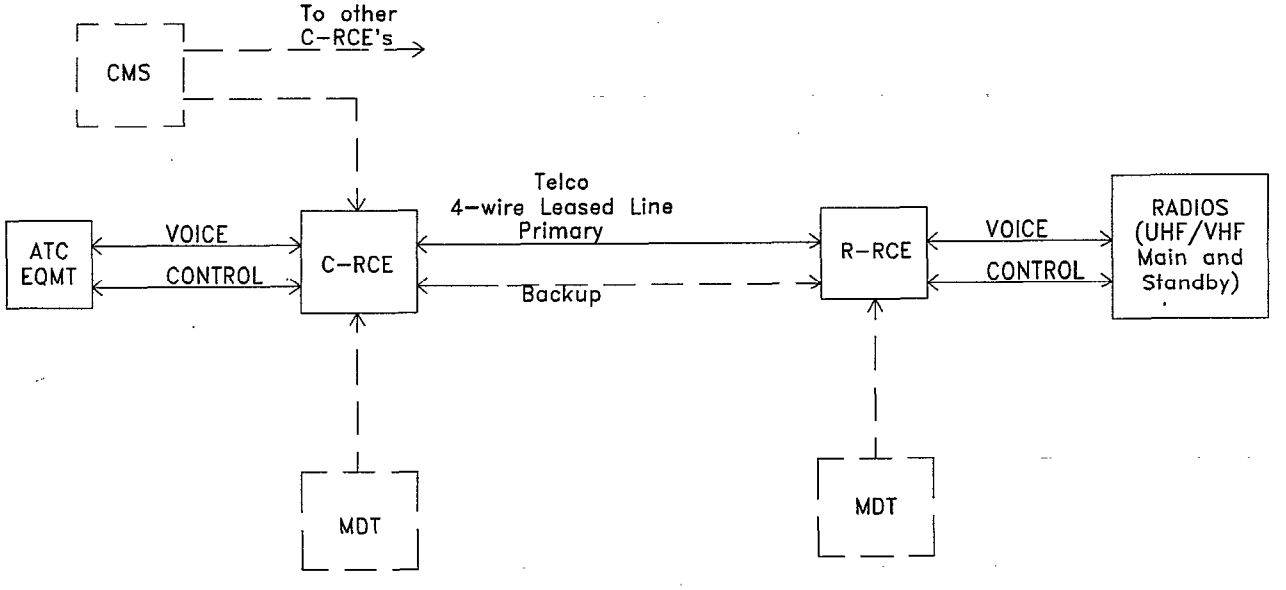


Figure 2-10. Radio Control Equipment

*

CHAPTER 3. STANDARDS AND TOLERANCES

60. GENERAL.

This chapter prescribes the standards and tolerances as defined and described in the latest edition of Order 6000.15, General Maintenance Handbook for Airway Facilities for voice-frequency signaling systems (VFSS) equipment. All key performance parameters are identified by an arrow placed to the left of the applicable item.

61. FOUR-WIRE CIRCUIT CONFIGURATION.

Most VFSS facilities are now in four-wire line, four-wire equipment configuration. Although a hybrid unit may be installed, the send and receive audio paths are electrically isolated. This type of configuration is preferred to the two-wire to avoid hybrid crosstalk that results from line impedance changes that cause an unbalanced hybrid condition. The hybrid-balance standards and tolerances do not apply to facilities configured as four-wire line, four-wire equipment.

62. APPLICABILITY.

Standards and tolerances apply to the type of equipment used and not necessarily the type of facility controlled. For example, remote transmitter receiver (RTR) sites controlled by VFSS equipment are governed by paragraph 65 if tone channeling is used, paragraph 70 if LCT-CNTR-1A and RCT-RCAG-1A are used, and paragraph 66 if tone control is used. If the RTR is controlled by single-frequency equipment, then paragraph 69 applies.

63.-64. RESERVED.

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*	
			Initial	*Operating*
65. TONE CHANNELING EQUIPMENT (CA-1621, CA-1708, FA-5390, FA-8187, FA-8735, VFSC-6/VFRC-6, B5, D103, D104).				
→ **a. Audio mode (am) sender output level.**	103, 110e(4)	-5 dBm	-5 dBm	+0, -1 dB
→ **b. Frequency shift (fs) output level.**	103, 110e(5)	-16 dBm	-16 dBm	±1 dB
→ **c. Am sender frequency**	104, 110e(6)	Specified frequency	±8 Hz	±10 Hz
→ **d. Fs sender frequency**	104, 110e(6)	Specified frequency	±8 Hz	±10 Hz
→ **e. Hybrid balance minimum isolation.**	110e(1) and (3)	25 dB	≥20 dB	≥20 dB
→ **f. Am receiver threshold**	105, 110e(9), 111e(2)	-28 dBm	-28 dBm	±3 dB
→ **g. Fs receiver threshold**	105, 110e(8), 111e(1), 112	-40 dBm	-40 dBm	±3 dB
h. Pulse generator mark/space bias.	110e(7)	10 percent	0 to +20 percent	0 to +20 percent

Parameter	Reference Paragraph	Standard	Tolerance/Limit	
			Initial	Operating
66. TONE CONTROL EQUIPMENT (CA-1668, FA-5250, FA-5531, FA-5652, VFSS-ST/VFSS-RT).				
→ **a. Am sender frequency**	104, 115d(1)	Specified frequency	±8 Hz	±10 Hz
→ **b. Am sender output level**	103, 115d(2), and (3)			
(1) 540 Hz		-16 dBm	-16 dBm	+0, -1 dB
(2) 2580 Hz		-15 dBm	-15 dBm	+0, -2 dB
(3) 2700 Hz		-15 dBm	-15 dBm	+0, -2 dB
(4) 2820 Hz		-12 dBm	+0, -1 dB	+0, -1 dB
(5) 2940 Hz		-12 dBm	+0, -1 dB	+0, -1 dB
c. Am receiver threshold	105, 116e(1) and (2)			
(1) 540 Hz		-37 dBm	±1 dB	±2 dB
(2) 2580 Hz		-36 dBm	±1 dB	±2 dB
(3) 2700 Hz		-36 dBm	±1 dB	±2 dB
→ **d. Hybrid balance minimum**	117	25 dB	≥20 dB	≥20 dB
e. Am sender nonsending output noise.	103	-60 dBm	-60 dBm	-60 dBm
67. CARRIER SIGNALING EQUIPMENT (CA-1703, CA-1709).				
→ **a. Am sender output level**	103, 120e(2)	-16 dBm	-16 dBm	+0, -2 dB
→ **b. Am sender frequency**	104, 120e(1)	Specified frequency	±8 Hz	±10 Hz
→ **c. Am receiver threshold**	105, 120e(3)	-37 dBm	±1 dB	±2 dB
68. TONE/SCAN EQUIPMENT (FA-5555, FA-5650).				
→ **a. Am sender output level**	103, 125e(3)	-12 dBm	-12 dBm	+0, -1 dB
→ **b. Am sender frequency**	104, 125e(3)	Specified frequency	±8 Hz	±10 Hz
→ **c. Am receiver threshold**	105, 125e(4)	10 dB	10 dB	±1 dB
→ **d. Fs sender output level**	103, 125e(5)	-12 dBm	-12 dBm	±1 dB
→ **e. Fs sender frequency**	104, 125e(5)	Specified frequency	+4 Hz	+8 Hz
→ **f. Fs receiver sensitivity**	105, 125e(6)	10 dB	10 dB	±1 dB
→ **g. Amplifier output**	125e(2)	-12 dBm	-12 dBm	±1 dB

Parameter	Reference Paragraph	Standard	Tolerance/Limit	
			Initial	Operating
69. IN-BAND SINGLE-FREQUENCY EQUIPMENT (VEGA 310, 312, 341, 345).				
→ **a. Am sender output level**	103, 130e(1)	-16 dBm	-16 dBm	±1 dB
→ **b. Am sender frequency**	104, 130e(1)	Specified frequency	±3 Hz	±6 Hz
→ **c. Am receiver threshold**	105, 130e(2)	-52 dB	-52 dB	+0 dB, -8 dB
70. DATA ABOVE VOICE EQUIPMENT LCT-CNTR-1A/RCT-RCAG-1A.				
a. Local terminal (ARTCC/ FSS/AFSS/ATCT).				
(1) Transmit				
(a) Input level . . . . . (test tone only)	135e(1)(c)	Commissioned value	Same as standard	±3 dB
→ (b) LIM output level . . . . . (test tone only)	135e(1)(g)			
1 Service type 3 . . . . . (FAA-S-1142a line [1])		-8 dBm	Same as standard	±3 dB
2 Service type 3 or 5 . . . . . (voice grade line)		Commissioned value [2]	±1.5 dB	±3 dB
* 3 Zero loss line		**-8 dBm**	Same as standard	±2 dB *
(c) LIM FSK input . . . . . level (modem tone only)	135e(1)(j)	-20 dBm	Same as standard	±3 dB
→ (d) LIM FSK output . . . . . level (modem tone only)	135e(1)(l)	16 dB below test tone level in a(1)(b) above	Same as standard	±6 dB
(2) Receive				
→ (a) LIM input level . . . . . (aggregate)	135e(2)(b)			
1 Service type 3 . . . . . (FAA-S-1142a line [1])		-17 dBm	+2, -3 dB	Same as initial
2 Service type 3 or 5 . . . . . (voice grade line)		-16 dBm	±3 dB	Same as initial
* 3 Zero loss line		**-8 dBm**	Same as standard	±2 dB *
(b) LIM level (U3A output)		-10 dBm	Same as standard	±4 dB
* (c) Audio output level . . . . . (line amp input)	135e(2)(f)	**Commissioned value**	Same as standard	±3 dB *

[1] The FAA-S-1142a specification lines should be phased out per paragraph 21. The standards and tolerances for service type lines are used in the interim.

[2] Operating power levels of lines interfacing a master demarcation system (MDS) should not exceed -13 dBm maximum averaged over a 3-second interval.

Parameter	Reference Paragraph	Standard	Tolerance/Limit	
			Initial	Operating
(d) LIM FSK input level (modem tone only)	135e(2)(i)			
1 Service type 3 (FAA-S-1142a line [1])		-33 dBm	+3, -12 dB	+7, -16 dB
2 Service type 3 or 5 (voice grade line)		-32 dBm	±3, -2 dB	+7, -16 dB
3 Zero loss line		16 dB below test tone level in a(2)(a) above	+3, -12 dBm	+7, -16 dB
(e) LIM level (TP3) (modem tone only)		-20 dBm	+3, -16 dBm	+7, -20 dBm
(f) Alarm level	135e(2)(j)	-32 dBm	Same as standard	±3 dB
b. Remote terminal.				
(1) Transmit				
(a) RIM input level	135e(3)(a)	Commissioned value	Same as standard	±3 dB
→ (b) LIM output level (test tone only)	135e(3)(e)			
1 Service type 3 (FAA-S-1142a line [1])		-8 dBm	Same as standard	±3 dB
2 Service type 3 or 5 (voice grade line)		Commissioned value [2]	Same as standard	±3 dB
* 3 Zero loss line		**-8 dBm**	Same as standard	±2 dB *
(c) LIM FSK input level	135e(3)(f)	-20 dBm	Same as standard	±3 dB
→ (d) LIM FSK output level	135e(3)(g)	16 dB below test tone level in a(1)(b) above	Same as standard	±6 dB
(2) Receive				
→ (a) LIM input level (aggregate)	135e(4)(a)			
1 Service type 3 (FAA-S-1142a line [1])		-17 dBm	+2, -3 dB	Same as initial
2 Service type 3 or 5 (voice grade line)		-16 dBm	±3 dB	Same as initial
* 3 Zero loss line		**-8 dBm**	Same as standard	±2 dB *
(b) LIM level (U3A output)		-10 dBm	Same as standard	±4 dB
(c) Audio output level (LIM)	135e(4)(c)	-10 dBm	Same as standard	±3 dB

[1] The FAA-S-1142a specification lines should be phased out per paragraph 21. The standards and tolerances for service type lines are used in the interim.

[2] Operating power levels of lines interfacing a master demarcation system (MDS) should not exceed -13 dBm maximum averaged over a 3-second interval.

Parameter	Reference Paragraph	Standard	Tolerance/Limit	
			Initial	Operating
→ (d) Audio output level (RIM) . .	135e(4)(e)	-10 dBm	Same as standard	±3 dB
→ (e) LIM FSK input level . . . . . (modem tone only)	135e(4)(k)			
1 Service type 3 . . . . . (FAA-S-1142a line [1])		16 dB below test tone level in b(2)(a) above	+2, -11 dB	+4, -14 dB
2 Service type 3 or 5 . . . . . (voice grade line)		16 dB below test tone level in b(2)(a) above	+3, -12 dB	+7, -16 dB
3 Zero loss line		16 dB below test tone level in b(2)(a) above	+3, -12 dB	+7, -16 dB
(f) LIM level (TP3)		-20 dBm	+3, -16 dB	+7, -20 dB
(g) Alarm level (TP3)	135e(4)(l)	-32 dBm	Same as standard	±3 dB
71. DATA ABOVE VOICE EQUIPMENT INTELECT 3130A.				
a. Local terminal				
(1) Transmit				
(a) Input level to 5130B . . . . . (test tone only)	136e(1)(d)	0 dBm	+0, -3 dBm	Same as initial
(b) Output level from . . . . . 5130B to line (test tone only)	136e(1)(e)			
1 Service type 3 . . . . . (FAA-S-1142a line [1])		-8 dBm	Same as standard	±3 dB
2 Service type 3 or 5 . . . . . (voice grade line)		Commissioned value	±1.5 dB	±3 dB
* 3 Zero loss line		-8 dBm	Same as standard	±2 dB *
(c) FSK output from . . . . . 5130B to line	136e(1)(h)	16 dB less than level in a(1)(b) above	Same as standard	±3 dB
(2) Receive				
(a) 5130B input level . . . . . (test tone)	136e(2)(f)			
1 Service type 3 . . . . . (FAA-S-1142a line [1])		-17 dBm	Same as standard	±2 dB
2 Service type 3 or 5 . . . . . (voice grade line)		-16 dBm	Same as standard	±3 dB

[1] The FAA-S-1142a specification lines should be phased out per paragraph 21. The standards and tolerances for service type lines are used in the interim.

Parameter	Reference Paragraph	Standard	Tolerance/Limit	
			Initial	Operating
3 Zero loss line		Commissioned value	Same as standard	±2 dB
(b) Signal level output from 5130B at RCV drop jack	136e(2)(l)	-6 dBm	Same as standard	±3 dB
(c) 5134 output to line amplifier		-16 dBm	Same as standard	±3 dB
b. Remote terminal.				
(1) Receive				
(a) Input level to 5130B (test tone only)	136e(3)(b)			
1 Service type 3 (FAA-S-1142a line [1])		-17 dBm	Same as standard	±3 dB
2 Service type 3 or 5 (voice grade line)		Commissioned value	Same as standard	±2 dB
* 3 Zero loss line		-8 dBm	+0, -3 dBm	Same as initial *
(b) Output from 5130B (test tone only)		-6 dBm	±3 dBm	Same as initial
(c) Output from 5135A to transmitters (test tone only)	136e(3)(g)	-10 dBm	±3 dBm	Same as initial
(2) Transmit				
(a) Input level to 5135A (test tone only)	136e(4)(f)	0 dBm	+0, -6 dBm	Same as initial
(b) Output level from 5135A (test tone only)		-6 dBm	±2 dBm	Same as initial
(c) Input level to 5130B (test tone only)		-6 dBm	±2 dBm	Same as initial
(d) Output from 5130B to line (test tone only)	136e(4)(d)			
1 Service type 3 (FAA-S-1142a line [1])		-8 dBm	Same as standard	±3 dB
2 Service type 3 or 5 (voice grade line)		Commissioned value	Same as standard	±2 dB
* 3 Zero loss line		-8 dBm	+0, -3 dBm	Same as initial *
(e) Fsk output to line	136e(4)(k)	16 dB below level specified in (2)(d) above	±3 dBm	Same as initial
72. DATA ABOVE VOICE EQUIPMENT LCT-SFO-1 AND -2/ RCT-SFO-1 AND -2 (RCO).				
a. Local terminal.				
(1) Transmit				

[1] The FAA-S-1142a specification lines should be phased out per paragraph 21. The standards and tolerances for service type lines are used in the interim.

Parameter	Reference Paragraph	Standard	Tolerance/Limit	
			Initial	Operating
(a) Input level . . . . . test tone only)	137e(1)(c)	Commissioned value	Same as standard	±3 dB
(b) LIM output level . . . . . (test tone only)	137e(1)(e)			
1 Service type 3 . . . . . (FAA-S-1142a line [1])		-8 dBm	Same as standard	±3 dB
2 Service type 3 or 5 . . . . . (voice grade line)		0 dBm	Same as standard	±3 dB
* 3 Zero loss line		-8 dBm	Same as standard	±2 dB *
(c) LIM output level . . . . . (keyer tone only)	137e(1)(h)	16 dB below test tone level in a(1)(b) above	±3 dB	±6 dB
(2) Receive				
(a) LIM input level . . . . . (aggregate)	137e(2)(a)			
1 Service type 3 . . . . . (FAA-S-1142a line [1])		-17 dBm	+2, -3 dB	Same as initial
2 Service type 3 or 5 . . . . . (voice grade line)		-16 dB	+4 dB	Same as initial
* 3 Zero loss line		-8 dBm	Same as standard	±2 dB *
(b) Audio output level . . . . . (test tone only)	137e(2)(d)	Commissioned value	Same as standard	±3 dB
b. Remote Terminal				
(1) Transmit				
(a) LIM input level	137e(3)(b)	Commissioned value	Same as standard	±3 dB
(b) LIM output level . . . . . (test tone only)	137e(3)(d)			
1 Service type 3 . . . . . (FAA-S-1142a line [1])		-8 dBm	Same as standard	±3 dB
2 Service type 3 or 5 . . . . . (voice grade line)		0 dBm	Same as standard	±3 dB
* 3 Zero loss line		-8 dBm	Same as standard	±2 dB *
(2) Receive				
(a) LIM input level . . . . . (aggregate)	137e(4)(a)			
1 Service type 3 . . . . . (FAA-S-1142a line [1])		-17 dBm	+2, -3 dB	Same as initial

[1] The FAA-S-1142a specification lines should be phased out per paragraph 21. The standards and tolerances for service type lines are used in the interim.

Parameter	Reference Paragraph	Standard	Tolerance/Limit	
			Initial	Operating
2 Service type 3 or 5 ..... Voice grade line		-16 dB	±4 dB	Same as initial
* 3 Zero loss line		–8 dBm	Same as standard	±2 dB *
(b) Audio output level ..... (LIM)	137e(4)(c)	Commissioned Value	Same as standard	±3 dB
(c) LIM level (TP3)	137e(4)(d)	-10 dBm	Same as standard	±3 dB
(d) Alarm level (TP3)	137e(4)(f)	-25 dBm	±3 dB	±3 dB
72-1. RADIO CONTROL EQUIPMENT				
a. Local terminal (C-RCE).				
(1) Transmit				
* (a) Audio output level to position...	138e(1)(n)	Commissioned Value	±3 dB	±6 dB *
(b) DVC output level to telco ..... (test tone only)	138e(1)(o)			
1 Service type 3 ..... (FAA-S-1142a line[1])		-8 dBm	±4 dB	±6 dB
2 Service type 3 or 5 ..... (voice grade line)		0 dBm	±4 dB	±6 dB
3 Zero loss line		-8 dBm	±2 dB	±4 dB
* (c) Modem output level		11 dB below DVC output level	±3 dB	±6 dB *
(2) Receive				
(a) DVC input level from position.. (test tone only)	138e(1)(n)	-5 dBm	±3 dB	±6 dB
(b) DVC input level from telco.....	138e(1)(o)			
1 Service type 3 ..... (FAA-S-1142a line[1])		-17 dBm	±3 dBm	±6 dB
2 Service type 3 or 5 ..... (voice grade line)		-16 dBm	±4 dB	±6 dB
3 Zero loss line		-8 dBm	±2 dB	±4 dB
b. Remote terminal (R-RCE).				
(1) Transmit				
(a) DVC output level to radio ..... transmitter (test tone only)	138e(2)(n)	Commissioned Value	±3 dB	±6 dB

[1] The FAA-S-1142a specification lines should be phased out per paragraph 21. The standards and tolerances for service type lines are used in the interim.

Parameter	Reference Paragraph	Standard	Tolerance/Limit Initial	Tolerance/Limit Operating
(b) DVC output level to telco (test tone level)	138c(2)(o)			
1 Service type 3 ..... (FAA-S-1142a line[1])		-8 dBm	±3 dB	±6 dB
2 Service type 3 or 5 ..... (voice grade line)		0 dBm	±4 dB	±6 dB
3 Zero loss line		-8 dBm	±2 dB	±4 dB
* (c) Modem output level		11 dB below DVC output level	±3 dB	±6 dB *
(2) Receive				
(a) Audio input level from radio..... receiver (test tone only)	138e(2)(n)	Commissioned Value	±3 dB	±4 dB
(b) DVC input level from telco..... (aggregate)	138e(2)(o)			
1 Service type 3 ..... (FAA-S-1142a line[1])		-17 dBm	±3 dB	±6 dB
2 Service type 3 or 5 ..... (voice grade line)		-16 dBm	±4 dB	±6 dB
3 Zero loss line		-8 dBm	±2 dB	±4 dB
73. POWER SUPPLIES.				
a. Output level	107	As specified voltage	±5 percent	±5 percent
b. Ripple	107	≤5 percent	≤5 percent	≤5 percent
74.-79. RESERVED				

[1] The FAA-S-1142a specification lines should be phased out per paragraph 21. The standards and tolerances for service type lines are used in the interim.

CHAPTER 4. PERIODIC MAINTENANCE

80. GENERAL.

This chapter establishes all maintenance activities that are required for air/ground radio control voice-frequency signaling systems (VFSS) equipment. The chapter is divided into two sections. The first section identifies the performance checks (i.e., tests, measurements, and operations) of the normal operating functions that are necessary to determine whether operation is within established tolerance/limits. The second section identifies other tasks that are necessary to prevent deterioration and/or ensure reliable operation. Refer to the latest edition of Order 6000.15, General Maintenance Handbook for Airway Facilities for additional general guidance.

81. PERIODIC MAINTENANCE.

A periodic adjustment of the entire radio control system will often preclude the need to make unscheduled adjustments. A parameter being corrected should always be adjusted to the initial tolerance/limits prescribed for it in chapter 3.

82. APPLICABILITY.

The following schedule describes equipment maintenance events, NOT facility maintenance events. RCAG (tone channeling) describes a one-way tone control group of equipment which is primarily used at RCAG's but can be used at other facilities requiring one-way control, for example, RTR's.

83.-84. RESERVED.

Section 1. PERFORMANCE CHECKS

Performance Check	*Reference Paragraph*	
	Standards & Tolerances	*Maintenance Procedures*
85. WITHDRAWN--CHG 1		
* **86. WITHDRAWN--CHG 4** *		
87. SEMIANNUALLY (All Except RCE).		
a. Check tone sender output level		103
(1) Tone channeling	65a and b	110e(4), (5)
(2) Tone control	66b	115e(2), (3)
(3) Carrier signaling	67a	120e(2)
(4) Tone/scan	68a and d	125e(3), (5)
(5) In-band single frequency	69a	130e(1)
(6) Data above voice		106
(a) LCT-CNTR-1A/RCT-RCAG-1A	70a(1) and 70b(1)	135e(1), (3)
(b) Intelect 3130A	71a(1) and 71b(2)	136e(1), (4)
(c) LCT-SFO-1 and -2/ RCT-SFO-1 and -2 (RCO)	72a(1) and 72b(1)	137e(1), (3)

Section 1. PERFORMANCE CHECKS (Continued)

Performance Check	*Reference Paragraph*	
	Standards & Tolerances	*Maintenance Procedures*
b. Check tone sender frequency		104
(1) Tone channeling	65c and d	110e(6)
(2) Tone control	66a	115d(1)
(3) Carrier signaling	67b	120e(1)
(4) Tone/scan	68b and e	125e(3), (5)
(5) In-band single frequency	69b	130e(1)
c. Check tone receiver threshold sensitivity		105
(1) Tone channeling	65f and g	105, 110e(8), (9)
(2) Tone control	66c	116e(1)
(3) Carrier signaling	67c	120e(3)
(4) Tone/scan	68c and f	125e(4), (6)
(5) In-band single frequency	69c	130e(1)
d. Check VFSS functions from the operator position for solid-state equipment.		
e Check tone channeling hybrid balance	65e	110e(1) and (3)
f. Check tone control hybrid balance	66d	117
* **88. ANNUALLY (All Except RCE)** Check VFSS power supply output level and ripple voltage (both solid-state and tube-type equipment).	73	107 *
89. RESERVED.		

Section 2. OTHER MAINTENANCE TASKS

Performance Check	Reference Paragraph	
	Standards & Tolerances	*Maintenance Procedures*
90. SEMIANNUALLY (TUBE-TYPE). Adjust (if necessary) tube-type VFSS equipment-tone sender output, tone sender frequency, tone receiver threshold/sensitivity, pulse generator mark/space ratio, and hybrid balance.		
a. Tone Channeling		
(1) CA-1621, CA-1708, and FA-5390	65	110, 112
(2) Lynch B5, D103	65	110, 111
b. Tone Control (CA-1668, FA-5250, FA-5531, FA-5652, VFSS-ST/VFSS-RT).	66	115, 116, 117
c. Carrier Signaling (CA-1703 and CA-1709).	67	120
91. ANNUALLY (SOLID-STATE).		
a. Data Above Voice Solid-State Systems. Adjust if necessary) all transmit, receive, and alarm levels at local and remote terminals.		
(1) LCT-CNTR-1A and RCT-RCAG-1A	70	135
(2) Intelect 3130A	71	136
(3) LCT-SFO-1 and -2 and RCT-SFO-1 and -2 (RCO)	72	137
b. Radio Control Equipment. Adjust (if necessary) tone sender level, tone sender frequency, pulse generator mark/space ratio, and hybrid balance.	72-1	138
c. All Other Solid-State Systems Adjust (if necessary) tone sender level, tone sender frequency, pulse generator mark/space ratio, and hybrid balance.		
(1) Tone channeling FA-8187, FA-8735, and VFSS/GRM	65	110
(2) Tone/scan FA-5555, FA-5650	68	125
(3) In-band single frequency Vega 310, 341, 345	69	130
* **92. AS REQUIRED.** Perform archive update of CMT status log (RCE Only).		139 *
93.-94. RESERVED.		

CHAPTER 5. MAINTENANCE PROCEDURES

100. GENERAL.

a. This chapter establishes the procedures for accomplishing the various essential maintenance activities that are required for the air/ground radio control VFSS equipment on either a periodic or incidental basis. The chapter is divided into two sections. The first section describes the procedures to be used in making the performance checks listed in chapter 4, section 1. The second section describes the procedures for doing the tasks listed in chapter 4, section 2. Refer to the latest edition of Order 6000.15, General Maintenance Handbook for Airway Facilities, for additional general guidance.

b. Table 5-1 lists the test equipment required to perform the procedures of this chapter. Technical personnel should be familiar with the use of test equipment and should consult the test equipment manuals for detailed guidelines.

101. FAA FORM 6000-8 ENTRIES.

Order 6000.15 contains policy, guidance, and detailed instructions for field use of FAA Form 6000-8, Technical Performance Record as applicable to VFSS equipment. Entries shall be made in accordance with the instructions outlined in Order 6000.15. Figure 5-1 is a sample FAA Form 6000-8 that shows typical entries for normal and unsatisfactory conditions that may be encountered.

102. NOMINAL INPUT LEVELS.

The nominal input level of these procedures is the desired input level under 1000 Hz net loss conditions of the line; i.e., the control point output level plus the 1000 Hz net loss of the line. Do not add seasonal variation figures to the nominal loss because seasonal variation is included in the procedure when the receiver sensitivity adjustment (receiver threshold level) is made.

Table 5-1. TEST EQUIPMENT

GENERIC NAME	*PREFERRED ITEM*	*SUBSTITUTE ITEM*
Multimeter or Volt-Ohm Milliammeter (VOM)	Digital Multimeter Fluke 8000A or equal	Simpson VOM Model 260 or Triplett VOM Model 630NA
Vacuum-Tube Voltmeter (VTVM)	FET Voltmeter, AC, DC Triplett Model 801	Hewlett-Packard Model 400D
Oscilloscope		
Transmission Test Set (Power Level Meter or DBM/DBA Meter)	Wavetek Model 430	Northeast Electronics Model TTS-37/B, Alectra Model 11B, or Hewlett-Packard 3551A Transmission Measuring Set (TMS)
	or	
	Wavetek Model 424	None
Voice-Frequency Control System (VFCS) Test Set	FA-5662 or CA-1702	None

Table 5-1. TEST EQUIPMENT (CONTINUED)

GENERIC NAME	*PREFERRED ITEM*	*SUBSTITUTE ITEM*
Audio Oscillator or Function Generator	Function Generator, Clark-Hess Model 748	Hewlett-Packard HP-200
Electronic Frequency Counter	Systron-Donner Model 6153-50A Counter-Timer	Any equivalent counter

Section 1. PERFORMANCE CHECK PROCEDURES

103. SENDER OUTPUT LEVEL CHECK.

A bridging measurement across the FAA/line demarcation terminals shall be made and recorded on FAA Form 6000-8, Technical Performance Record - Continuation or Temporary Record/ Report Form. Correct any out-of-tolerance condition to the initial tolerance condition. See Order 6000.22, Maintenance of Analog Lines, for line restoration requirements.

104. SENDER FREQUENCY CHECK.

Measure and record on FAA Form 6000-8 the tone sender frequency. Use an electronic frequency counter connected in accordance with the equipment's appropriate frequency adjustment procedure. (See section 2.) Readjust any out-of-tolerance condition to its initial tolerance condition using the appropriate procedure of section 2. Those out-of-tolerance senders without adjustable frequencies should be removed from service and returned to the FAA Logistics Center if the as-measured frequency cannot provide reliable operation.

105. RECEIVER THRESHOLD CHECK.

Measure and record on FAA Form 6000-8 the receiver input level at which relay pull-in operation just occurs. Adjust any out-of-tolerance condition to the initial tolerance condition, using appropriate procedures of section 2.

106. DATA ABOVE VOICE SYSTEM LEVEL CHECKS.

Measure and record on FAA Form 6000-8 the transmit and receive levels for the local and remote terminals. Adjust any out-of-tolerance condition to the initial tolerance condition, using the appropriate procedures described in section 2.

107. POWER SUPPLY CHECK.

Measure the output voltage, the ripple of the dc supplies, and the dc voltages at each sender and receiver test point or terminal board. Performance checks should be accomplished under maximum load conditions and at minimum traffic periods.

108.-109. RESERVED.

Section 2. OTHER MAINTENANCE TASKS PROCEDURES

Subsection 1. TONE CHANNELING

110. CA-1621, CA-1708, FA-5390, AND FA-8187 ADJUSTMENT.

a. Object. This procedure adjusts the tube-type VFSS equipment used in tone channeling control of remote center air/ground (RCAG) facilities.

b. Discussion.

(1) The audio mode (am) and frequency shift (fs) senders have two adjustments each, frequency and output level. These adjustments are straightforward and require no special techniques. The output level of

TECHNICAL PERFORMANCE RECORD — **CONTINUATION OR TEMPORARY RECORD/REPORT FORM**

FACILITY: KARRIS RCAG (ATCT, FSS, ARTCC, VOR, LOC, ETC.)
DATES: FROM 12/14/93 TO
SUPERVISOR'S SIGNATURE:
LOCATION: FORT WORTH, TEXAS (CITY, STATE, AIRPORT, OTHER)
EQUIPMENT: RCT-RCAG-1A (A/G, DF, COMPONENTS, ETC.)
FREQ.: CHANNEL 46 (123.475/241.0)

DATE	TIME	TRANSMIT (dBm): TEST TONE RTM INPUT	TEST TONE LTM OUTPUT	LTM FSK INPUT	LTM FSK OUTPUT	RECEIVE (dBm): TEST TONE LTM INPUT	TEST TONE U3A OUTPUT	TEST TONE @ RX SP. EQ.	TEST TONE RTM OUTPUT	TEST TONE RTM OUTPUT	LTM FSK INPUT	LTM FSK LEVEL (TP3)	FSK ALARM LEVEL (TP3)	POWER SUPPLY VOLTAGE (V)	POWER SUPPLY RIPPLE (mV)	REMARKS	INITIALS
NOMINAL		-10	0	-20	-16	0	-10	-10	-10	-10	-16	-20	-32	12.0	0	ZERO LOSS LINE -10 dBm To TX -10 dBm From RX	
		-13	-2	-23	-22	-2	-14	-13	-13	-13	-32	-40	-35	11.4	0	LOWER OPERATING LIMIT	
		-7	+2	-17	-10	+2	-6	-7	-7	-7	-9	-13	-29	12.6	600	UPPER OPERATING LIMIT	
12/14	1400	-10	-1	-21	-16.5	0	-15	-9	-10	-10	-18	-22	-33	11.8	250	SEMI / ANNUAL MAINT. CHECK	ML
12/14	1430						-10									ADJ. REC. U3A OUTPUT	ML

FAA Form 6000-8 (3-76) FORMERLY FAA FORM 418-24

U S GOVERNMENT PRINTING OFFICE 1983-673-913/574

Figure 5-1. Form 6000-8, with Typical Entries

the fs sender will not be the same for its two discrete frequencies. This is normal and is due to impedance changes in terminal equipment when the fs sender is keyed.

(2) The line balance network of the hybrid unit is adjusted for the best line balance condition. Although each unit has built-in capacitors and adjustable controls, these may not be in the correct combination for the best line balance. Figure 5-2 shows several variations of the balance network unit.

(3) Use the fs receiver bias and input gain controls (in tube-type VFSS) to set the cutoff bias and saturation level of the dc amplifier. When the mark signal (2847.5 Hz) is received, a high negative voltage is desirable to drive the dc amplifier tube into cutoff, thereby preventing noise pulses of moderate amplitude from causing intermittent conduction. On the space signal (2762.5 Hz), a high positive voltage will overcome the cathode bias of +15 volts and drive the dc amplifier well into conduction. Equal voltage output from the discriminator on the mark and space tones is not necessary, except in Lynch equipment.

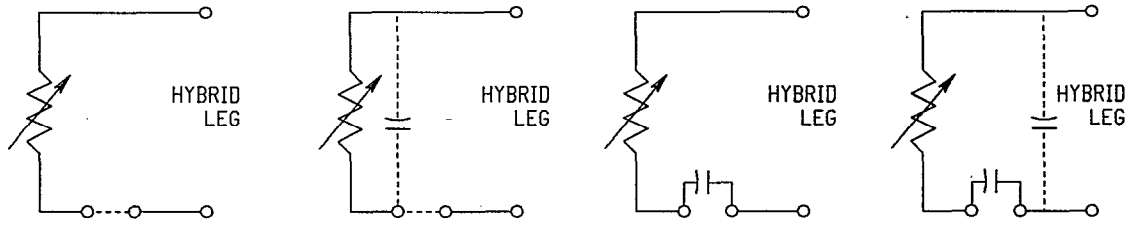


Figure 5-2. Variations of Line Balance Network

(4) The am receiver has two adjustments, bias and input gain. The bias control varies the time constant of a resistance-capacitance (RC) network to minimize distortion in the mark/space output signal. The input gain control is used to adjust the threshold of relay operation to the specified minimum input signal level. If the receiver is adjusted to respond to signals below the specified level, noise impulses on the control line may cause spurious operation of the am receivers when the receiver input circuits are not shorted.

(5) The CA-1620 and FA-5397 voice frequency control systems (VFCS) pulse the VFSS 935 Hz am sender at 14 dot-cycle and 10 dot-cycly rates, respectively. The mark-to-space ratio of both units is 55/45 percent. Allowable deviations from this ratio are documented in paragraph 65h. An oscilloscope with a horizontal sweep calibrated close to 10 milliseconds may be used to measure this bias.

c. Test Equipment Required.

(1) Volt-ohm milliammeter (vom).

(2) Transmission test set (TTS).

(3) CA-1702 or FA-5662 VFSS test set.

(4) Vacuum-tube voltmeter (vtvm).

(5) Audio oscillator or function generator.

(6) Electronic frequency counter.

(7) Oscilloscope.

d. Conditions.

(1) Coordinate with the control facility for a shut down of the RCAG channel for maintenance.

(2) The send terminal (ARTCC) and receive terminal (RCAG) may be aligned as a system if intensive coordination is possible. Otherwise, the terminals must be adjusted separately, mainly by substituting the output of the VFSS test set at the receive terminal for the nominal tone level delivered from the telephone company (telco) line.

(3) Perform all sender level measurements at the hybrid equipment jack across a 600-ohm resistive load.

e. Detailed Procedure.

(1) Hybrid Balance (Send Terminal).

(a) Use one of the test circuits as shown in figure 5-3.

(b) Remove the hybrid unit from its cabinet. Use the test cable to reconnect it to its cabinet connector.

(c) Connect a jumper across terminals 15 and 16 of the pulse generator terminal board. This removes the short circuit across the output terminals of the am senders.

(d) Disable the fs sender.

(e) Momentarily key the main/standby am sender.

(f) Adjust the line balance control(s) for a minimum, as read on the TTS. Add or remove capacitance for the best balance.

(g) Unkey the am sender.

(h) Calculate the degree of hybrid balance by measuring the am sender level into the hybrid transformer and the level at the voice equipment jack. The difference must exceed the limit specified in paragraph 65e. If it does not, refine the adjustment made in step (f).

(i) Remove the jumper connected in step (c).

(j) Restore the fs sender to normal operation.

(k) Plug the hybrid unit into its connector in the cabinet.

(2) Remove the test equipment.

(3) Hybrid Balance (Receive Terminal).

(a) Use one of the test circuits as shown in figure 5-4.

(b) Remove the hybrid unit from the cabinet. Use the test cable to reconnect it to its cabinet connector.

(c) Connect a jumper across terminals 9 and 10 of the voice-frequency (vf) remote-control relay-panel terminal board. This removes the short circuit across the input terminals of the am receivers.

(d) Set the audio oscillator for 1-volt output at 1000 Hz.

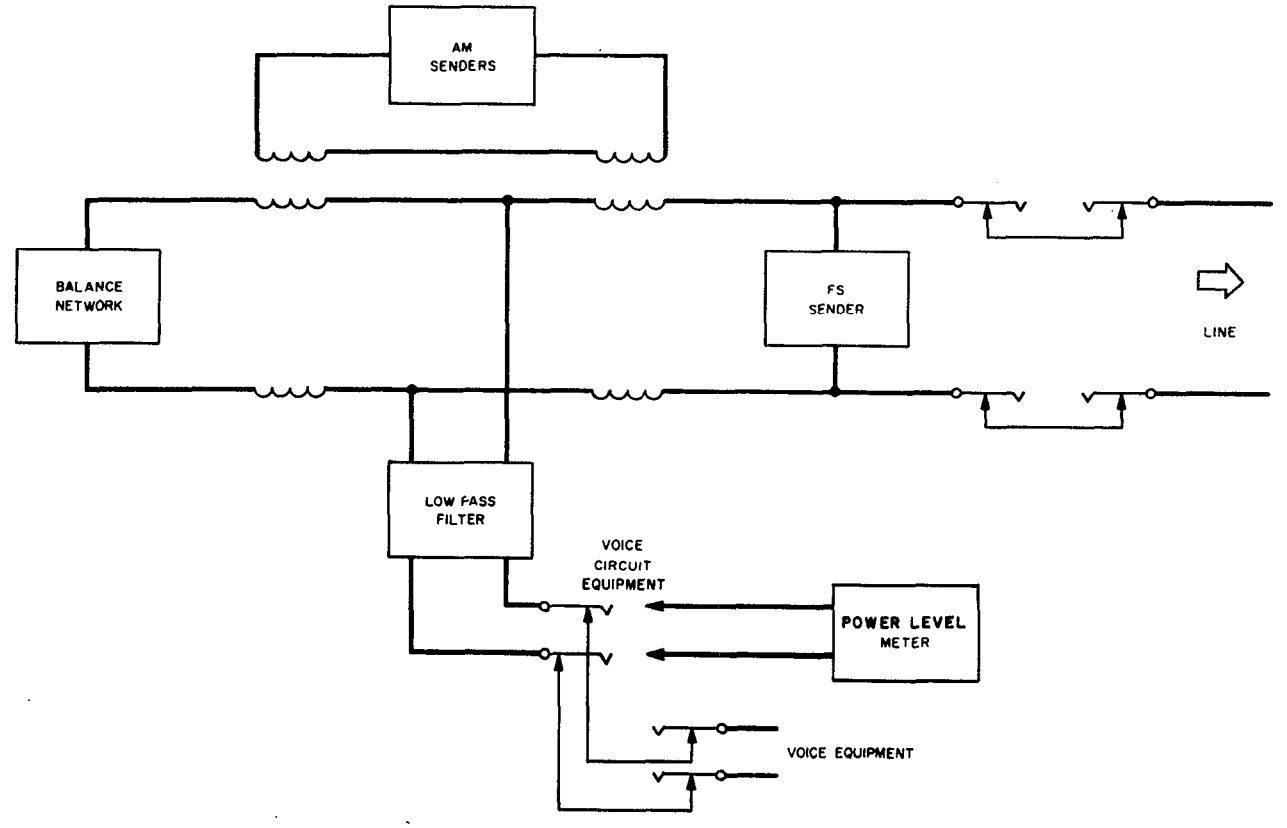
(e) Adjust the line balance control(s) for a minimum reading on the TTS meter. Add or remove capacitance for the best balance.

(f) Determine the degree of hybrid balance by measuring the 1000 Hz audio signal entering the hybrid transformer and at the input terminals of any am receiver. The difference must exceed the limit specified in paragraph 65e. If it does not, refine the adjustment made in step (e).

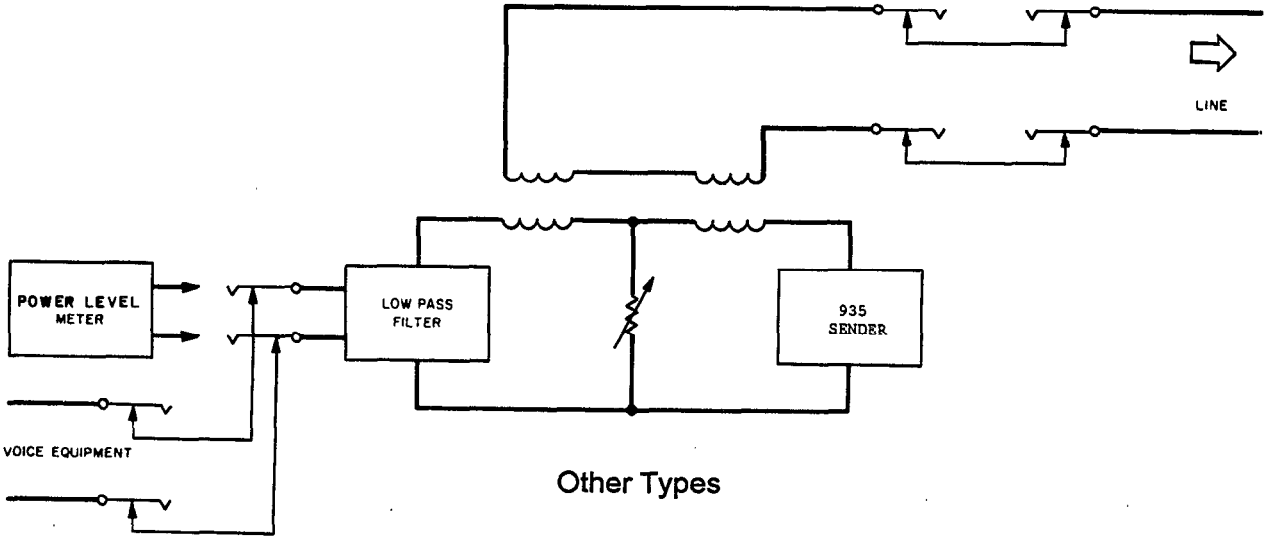
(g) Disconnect the test equipment and cable.

(h) Remove the jumper from terminals 9 and 10.

(i) Plug the hybrid unit into its connector in the receive cabinet.



CA And FA Types



Other Types

Figure 5-3. ARTCC Hybrid Adjustment

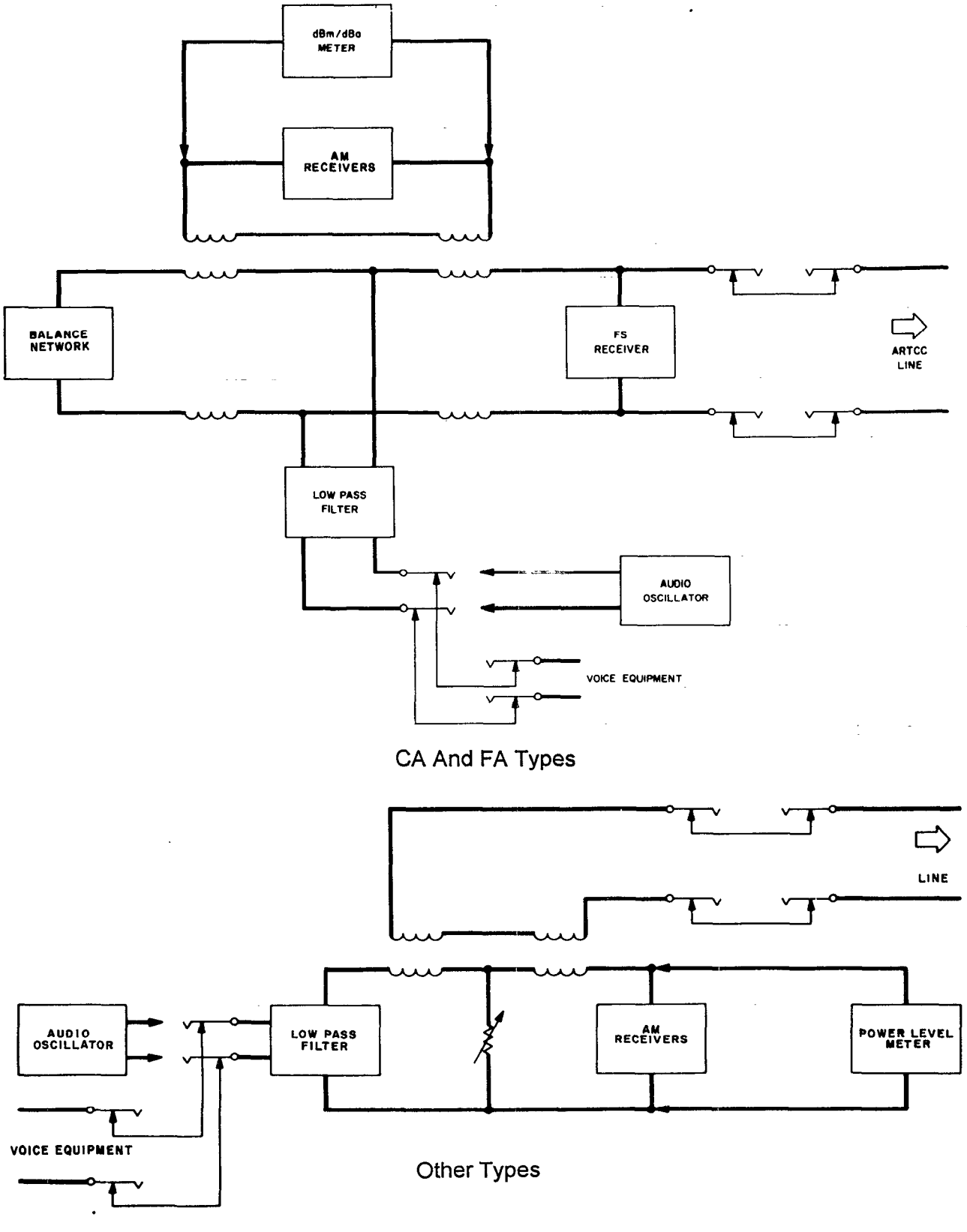


Figure 5-4. RCAG Hybrid Adjustment

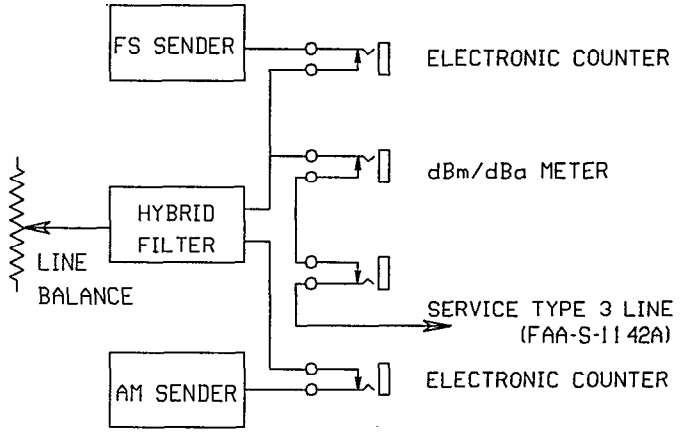


Figure 5-5. Sender Adjustment

(4) AM Sender Output Level.

(a) Connect the test equipment as shown in figure 5-5.

(b) Connect a jumper across terminals 15 and 16 of the pulse generator terminal board. This action removes the short circuit across the output terminals of the am senders.

(c) Disable the fs sender.

(d) Key each am sender momentarily and adjust its output to the level specified in paragraph 65a.

(e) Remove the jumper connected in step (b).

(f) Restore the fs sender to normal operation.

(g) Remove the test equipment.

(5) FS Sender Output Level.

(a) Connect the test equipment as shown in figure 5-5.

(b) Key the fs sender to the spacing mode by operating relay K8 in the pulse generator panel. Adjust the output to the level specified in paragraph 65b.

(c) Release relay K8 and remove the test equipment.

(6) AM and FS Sender Frequency Adjustment.

(a) Connect an electronic counter to the send filter-out jack of the am sender to be measured.

(b) Unplug the fs sender.

(c) Key each am sender momentarily and read its frequency on the counter.

(d) If necessary, adjust the fine tuning control to set the frequency within the limits specified in paragraph 65c.

(e) Reconnect the fs sender.

(f) Read the fs sender marking (high-frequency) mode on the counter.

(g) Key the fs sender to its spacing (low-frequency) mode and read the frequency on the counter.

(h) If necessary, adjust the fine tuning control to set the frequency within the limits specified in paragraph 65d.

(i) Remove all test equipment.

(7) Pulse Generator Mark-to-Space (M/S) Ratio.

(a) Connect the test equipment as shown in figure 5-6.

(b) Disconnect cable from J3 on the M/S relay panel associated with the pulse generator panel being checked.

(c) Connect the vertical input of an oscilloscope to pulse generator panel terminals 9(+) and 27(−). The oscilloscope should have a calibrated horizontal sweep capable of displaying a sweep of 10 milliseconds per division.

(d) Place a jumper between pulse generator panel terminals 11 and 28. Adjust the oscilloscope triggering for stable sweep. Measure the pulse duration and the space between pulses. The mark time (pulse duration) shall be 55 percent and the space time (space between pulses) shall be 45 percent. Allowable deviations from this standard are specified in paragraph 65h.

(e) Remove all test equipment and the jumper, plug in the VFSS equipment power supply, and restore operation.

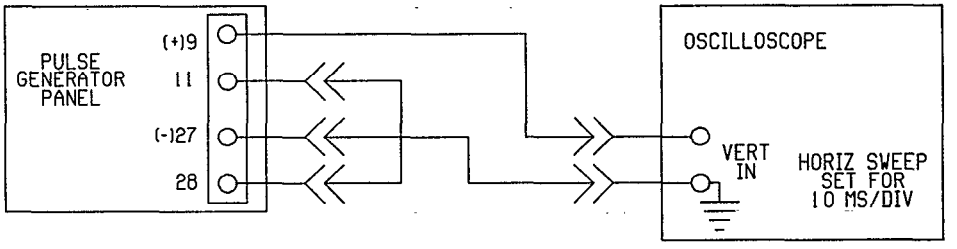


Figure 5-6. Pulse Generator Mark-to-Space Ratio

(8) FS Receiver Threshold.

(a) Connect the test equipment as shown in figure 5-7.

(b) Adjust the test set level for a 2762.5 Hz signal into the hybrid equipment jack at a level equal to the threshold level stated in paragraph 65g (as measured with the TTS bridged across hybrid input).

(c) Connect a vtvm between the grid of the relay driver (DC AMP) tube and ground. The meter should be connected to TP in the type CA-1621 and to pin 7 of V3602 through a tube socket extender in the types CA-1708 and FA-5390 equipments. In solid-state equipment, connect the vtvm between pin 2 of Z1 and ground.

(d) Adjust the fs receiver GAIN control for maximum sensitivity.

(e) Adjust the BIAS control for +20 V dc at the grid of the relay driver (DC AMP) tube. For FA-8187 VFSS, adjust the BIAS control so the waveform at pin 2 of Z1 is centered around a 0 V dc level.

(f) Adjust one GAIN control so that relay K1 just closes.

(g) Change the test set to 2847.5 Hz at approximately the same level used in step (b).

(h) Confirm that a negative voltage is present on the grid of the relay driver (DC AMP) tube. For solid-state VFSS, module pin 9 is at ground when there is input to pin 5 of the module.

(i) Remove the vtvm and confirm that the threshold of operation K1 is within the tolerances specified in paragraph 65g. Refine the adjustment of the GAIN control as necessary.

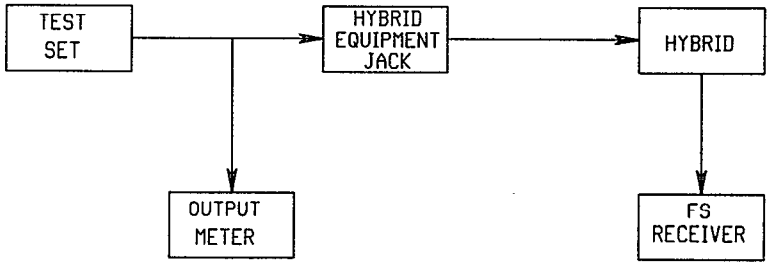


Figure 5-7. Frequency Shift Receiver Adjustment

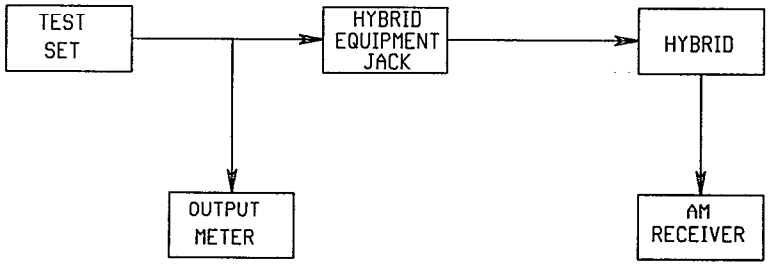


Figure 5-8. AM Receiver Adjustment

(j) Restore the equipment to normal.

(9) AM Receiver Threshold.

(a) Connect the test equipment at the RCAG terminal as shown in figure 5-8.

(b) Connect a jumper to terminals 9 and 10 of the remote control relay panel.

(c) Calibrate the test set. Set the signal parameters as follows:

1 Dotter rate, 12 pulses per second.

2 Dotter bias, 55/45 mark/space ratio.

3 Pulse generator, 60 ms.

(d) Adjust the test set to the receiver frequency and for a continuous tone at a level equal to the threshold level stated in paragraph 65f.

(e) Connect the vtvm between the grid of the relay driver (DC AMP) tube and ground. (The meter should be connected to TP in the type CA-1621 and to pin 7 of V3()02 through a tube socket extender in the types CA-1708 and FA-5390 equipments. In FA-8187 equipment, connect the vtvm between pin 6 of Z1 and ground.)

(f) Adjust the GAIN control for maximum sensitivity.

(g) Adjust the BIAS control for 20 V dc at the grid of the relay driver (DC AMP) tube. For FA-8187 VFSS, adjust the BIAS control so the waveform at pin 6, Z1 has an average value of zero volts.

(h) Adjust the GAIN control so that the threshold of operation of the output relay is within the tolerances specified in paragraph 65f. (Determine the output relay operation by observing the operation of an appropriate relay in the vf remote control relay panel or by removing the external lead from the normally open and armature (arm) relay terminals in the receiver cabinet and connecting an ohmmeter to these terminals.)

(i) Vary the output of level of the test set and confirm that the threshold of relay operation is within the tolerances specified in paragraph 65f.

(j) Using the test set, check for normal dial functions with the output level adjusted to (1) the standard level as received from the ARTCC and (2) the measured threshold level. (The test set output level should be measured while a continuous tone is present.)

(k) Restore equipment to normal.

111. LYNCH B5, D103 EQUIPMENT (RECEIVER THRESHOLD ONLY).

a. Object. This procedure adjusts the receiver threshold of the Lynch B5 am and D103 receivers.

b. Discussion. Because of the differences between the other tube-type receivers and the Lynch B5 am/D103 fs receiver, separate procedures for threshold adjustment are necessary.

c. Test Equipment Required. See paragraph 110c.

d. Conditions. Coordinate with the control facility for a shutdown of the system for maintenance.

e. Detailed Procedure.

(1) FS Receiver, Lynch Type D103.2.

(a) Connect the test equipment as shown in figure 5-9.

(b) Insert a shorted plug into the receiver RF IN jack.

(c) Plug a vom, set to a milliampere (mA) scale, into the mark MA jack, and record the meter reading. Unplug the meter.

(d) Plug the vom into the space MA jack, and record the meter reading. If this reading is not equal to the reading recorded in step (c), adjust the receiver balance control to obtain equality.

(e) Unplug the vom and the shorted plug in the RF IN jack.

(f) Use the test set to repeatedly shift from mark to space tones while adjusting the receiver gain control. The relay K1 in the remote control panel will operate each time the fs tone shifts to the space condition. Do not adjust the control for any greater receiver gain than is necessary.

(g) Measure the fs receiver threshold by varying the output level of the test set and noting the level at which relay K1 operates. The relay should be actuated within the levels specified in paragraph 65g.

(h) Remove all the test equipment and restore the VFSS terminal to normal operation.

(2) AM Receiver, Lynch B5.6.

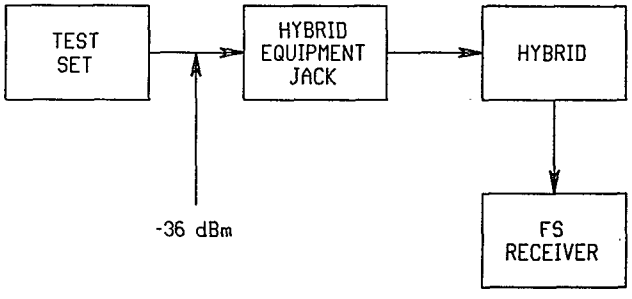


Figure 5-9. Frequency Shift Receiver Adjustment (Lynch Type)

(a) Connect the test equipment at the RCAG terminals as shown in figure 5-8.

(b) Connect a jumper across terminals 9 and 10 of the remote control relay panel.

(c) Calibrate the test set. Set the signal parameters as follows:

1 Dotter rate, 12 PPS.

2 Dotter bias, 55/45 mark/space ratio.

3 Pulse generator, 60 ms.

(d) With no signal output from the test set and the receiver GAIN at minimum setting, adjust receive milliamperes (ROMA) (bias) for 0.1 mA as measured on a vom plugged into the ROMA jack.

(e) Adjust the test set to the receiver frequency and a continuous tone at a level equal to the threshold level stated in paragraph 65f.

(f) Connect the ohmmeter into the TEST jack.

(g) Increase the receiver GAIN from minimum setting until relay RY-1 just operates, as indicated on the ohmmeter.

(h) Adjust the test set for a continuous tone level equal to the standard level as received from the ARTCC. Then adjust the test set for dotter pulses.

(i) Adjust the ROMA control for 165 ±15 volts as read on the linear 300 V dc scale.

(j) Repeat steps (e) through (i) until both conditions are satisfied without further adjustment.

(k) Apply a continuous tone and vary the test set output level to ascertain that the level for threshold of relay operation is within the levels specified in paragraph 65f.

(l) Using the test set, check for normal dial functions with the output level adjusted to (1) the standard level as received from the ARTCC and (2) the measured threshold level.

(m) Restore equipment to normal.

112. FA-8735 AND VFSS/GRM, FS RECEIVER THRESHOLD ONLY.

a. Object. This procedure adjusts the threshold level of fs receivers in the FA-8735 and VFSS/GRM solid-state tone channeling equipment.

b. Discussion. This procedure will make the fs receiver less sensitive to high input receive levels.

c. Test Equipment Required.

(1) Audio oscillator, function generator, or VFCS test set.

(2) TTS.

(3) Oscilloscope.

d. Conditions.

(1) Coordinate a maintenance shutdown with the control facility and remove the equipment from service.

(2) Produce input levels locally or remotely from control site.

e. Detailed Procedure.

(1) Remove ac power to receive terminal. Mount fs receiver module on extender card. Restore ac power.

(2) Using a scope, measure and adjust the bias voltage at the base of Q6 to −8 V dc. Remove extender card.

(3) When the 2762.2-Hz control tone level applied to the hybrid input is as specified in paragraph 65g, adjust the gain control for K1 pull-in (no chatter). Should this be unobtainable, check 2N760A transistors for aging, and replace with a JAN 2N760A type.

(4) When maintenance is complete and operation is satisfactory, return the equipment to service and notify the control facility.

113.-114. RESERVED.

Subsection 2. TONE CONTROL

115. AM SENDER ADJUSTMENT.

a. Object. This procedure determines that the sender frequency and gain controls are properly adjusted.

b. Test Equipment Required.

(1) Electronic frequency counter.

(2) TTS.

c. Conditions. Connect all equipment for normal operation.

d. Detailed Procedure. Refer to table 5-2 for other test points and controls, equivalent to those given below.

(1) AM Sender Frequency Adjustment.

(a) Connect the electronic counter into the send filter-out jack of the sender to be adjusted.

(b) Key the sender by grounding TP( )03 in the CA-1668 or TP( )02 in the FA-5250 located on the front of the sender.

(c) Adjust C( )01 to within the initial tolerance of paragraph 66a.

(2) AM Sender Gain Adjustment, Send Terminal (FSS).

(a) Bridge the TTS into the proper send-filter hybrid-line monitor jack (two-wire or four-wire).

Table 5-2. EQUIVALENT TEST POINTS, TERMINALS, AND CONTROLS FOR MAINTENANCE PROCEDURES

PROCEDURE PARAGRAPH	*CA-1668*	*FA-5250*	*FA-5531*	*FA-5652*	*VFSS-ST/RT*
117e(1)(a)	J2107	J2107	J301	J208	J2
117e(1)(a)	TB2/term 1 and 2	TB2/term 1 and 2	TB103, term 7 and 8	TB102, term 3 and 4	TB2, term 1 and 2
117e(1)(b)	J2109	J2109	TB103, term 9 and 10 (bridging)	J210	J9
117e(1)(b)	R2102	R2102	R302	R202	R2
117e(1)(b)	R2101	R2101	R301	R201	R1
117e(2)(a)	J201, term 8 and 10	J201, term 15 and 18	TB103, term 1 and 2	TB201, term 7 and 8	J1
117e(2)(b)	TB2, term 9 and 10	TB2, term 9 and 10	TB103, term 3 and 4	TB102, term 9 and 10	TB2, term 9 and 10
117e(3)(a)	TB5, term 9 and 10	TB5, term 9 and 10	TB102, term 1 and 2	TB602, term 9 and 10	TB2, term 9 and 10
117e(3)(b)	J3201, term 8 and 16	J3201, term 7 and 8	TB103, term 3 and 4	TB602, term 9 and 10	AX5 D/E[1]
117e(4)(a)	TB5, term 11 and 12	TB5, term 11 and 12	TB103, term 5 and 6	TB204, term 6 and 7	TB2, term 11 and 12
117e(4)(b)	TB5, term 5 and 6	TB5, term 5 and 6	TB101, term 11 and 12	TB102, term 5 and 6	TB2, term 5 and 6
117e(6)(a)	J2209	J2209	TB103, term 7 and 8	J210	J3
117e(6)(b)	J2207	J2207	J301	J208	J8
115d(1)(b)	TP( )03	TP( )02	TB503	TP404	TP1
115d(1)(c)	C( )01	C501	None	C3	

[1]Use extender board.

(b) Key the 540 Hz sender and adjust its gain control for the level specified in paragraph 66b(1) as indicated on the TTS.

(c) Key the 2580 Hz sender and adjust its gain control for the level specified in paragraph 66b(2) as indicated on the TTS.

NOTE: Where two am tone senders are connected to the same load (i.e., outputs in parallel such as the 2700 Hz, 2820 Hz, and 2940 Hz), the output of any sender must be set with all senders connected to the load in the normal fashion but with all other tone senders unkeyed. This is very important with some types of equipment that offer considerable loading to the other circuit components when connected together.

(3) AM Sender Gain Adjustment, Receive Terminal (VOR/TACAN).

(a) Bridge the TTS into the proper receiver-filter hybrid-line monitor jack (two-wire or four-wire).

(b) Key the 2700 Hz sender and adjust its gain control for the level specified in paragraph 66b(3) as indicated on the TTS.

(c) If TACAN is installed, adjust the monitor tones (2820 Hz and 2940 Hz) to the tolerances listed in paragraphs 66b(4) and (5).

116. AM RECEIVER ADJUSTMENT.

a. Object. This procedure determines that the receiver gain and bias controls are properly adjusted.

b. Discussion. The receiver gain and bias controls determine the overall receiver sensitivity. If the receiver sensitivity is greater than 15 dB, the receiver relay may operate on line noise under no signal conditions. The receiver must be properly adjusted to compensate for varying line noise levels. At locations where maintenance must be performed without assistance from the remote end, the CA-1702 or FA-5662 vf control system tests sets, modified for use with VOR and TACAN tone control equipment, may be used. This method requires constant monitoring of the oscillator output with an electronic frequency counter to verify correct tone frequency generation.

c. Test Equipment Required.

(1) TTS.

(2) Vtvm.

(3) Vom.

(4) Optional Test Equipment.

(a) CA-1702 or FA-5662 VFCS test set.

(b) Audio oscillator or function generator.

d. Conditions. Connect all equipment for normal operation. Place the FUNCTION switch to the BRIDGE position on the TTS meter to avoid loading the circuit under test.

e. Detailed Procedure. The following procedure applies to all types of VORTAC tone control equipment. Both the continuous tone and dial-pulsing receivers are adjusted the same, with a further refinement of the dial-pulsing receiver for marking bias.

(1) Continuous Tone and Dial-Pulsing Receivers (540 Hz, 2580 Hz, 2700 Hz, 2820 Hz, and 2940 Hz).

(a) Tube-Type.

1 When the remote site demarcation input signal is at the level specified in paragraph 66c, adjust the gain control for (as measured with a TTS):

CA-1668, −8 dBm at TP3( )03;

FA-5250, −19 dBm at TP3( )03; and

FA-5531, −13 dBm at TP404

2 When the remote site demarcation input signal is at the level specified in paragraph 66c, adjust the bias control for (as measured with a vtvm):

CA-1668, +22 V dc at TP3( )06;

FA-5250, −60 V dc at TP3( )05; and

FA-5531, −14 V dc at TP408

NOTE: Ensure 12 dB sensitivity by reducing gain to a minimum, then increasing it until the relay activates. If the activation level (as measured at the gain test point) is less than 12 dB below the gain adjustment level, increase the bias voltage and repeat the process until a 12 dB difference is achieved. Observe the pull-in and dropout levels of the output relay. If more than a 4 dB difference exists, as measured at the gain adjustment test point, replace the relay.

(b) Solid-State Type. With the nominal input signal level at the remote site demarcation reduced 12 dB, adjust the gain (or input level on the FA-5652) for relay operation with the bias control fully clockwise.

(2) Dial-Pulsing Receiver (540 Hz). The dial-pulsing receiver requires a further adjustment for 50 to 65 percent marking bias. To do this, connect a vom across the normally-closed relay contacts with all external voltage removed from the contacts. Have the remote site technician dial a series of zeros (or generate these locally with the VFCS test set). Adjust the bias control for a meter indication between midscale and 15° beyond that point. If a more accurate device is available (oscilloscope or distortion test set), set the relay bias for 55 percent marking bias.

117. HYBRID UNIT ADJUSTMENT.

a. Object. This procedure determines if the hybrid balancing network is properly adjusted. The balancing network is adjusted to match the impedance of the voice-frequency telephone line or other circuit components. Proper balance or match is required in order that the hybrid transformer can function properly in the overall system operation.

b. Discussion. The voice-frequency signaling equipment can be connected in several different ways, and the methods for balancing the hybrid will vary. Therefore, determine how the hybrid unit is connected, and then select the proper procedure.

c. Test Equipment Required.

(1) Audio oscillator or function generator.

(2) TTS.

d. Conditions. Connect equipment for normal operation. The leased line shall meet specification FAA-S-1142a.

NOTE: A 600-ohm resistive dummy load SHOULD NOT BE substituted for the normal line impedance since the actual telco line impedance may or may not be 600 ohms.

e. Detailed Procedure. Refer to table 5-2 for other equipment test points equivalent to those given in the procedure steps to follow.

(1) Send Terminal with Four-Wire Termination (FSS).

(a) Connect a balanced output audio oscillator with a 3000-ohm resistor connected in series with each output terminal to J2107 of the filter hybrid unit. Adjust the frequency of the audio oscillator to 540 Hz. Adjust the audio oscillator level control for 0 dBm as indicated on the TTS bridged across terminals 1 and 2 of TB2.

(b) Terminate the TTS into J2109 and adjust the hybrid balance controls for a minimum reading as follows: Adjust R-2102 fully clockwise. Adjust R-2101 slowly through its full range and set it for best balance (minimum reading on the TSS). Note the TTS reading and compute the attenuation. See paragraph 66d for tolerance.

(2) Send Terminal with Two-Wire Termination (FSS).

(a) Key the 2580 Hz sender and adjust its gain control for a reading of 0 dBm on the TTS bridged across terminals 8 and 16 of J201 in the CA-1668 or terminals 15 and 16 of J201 in the FA-5250.

(b) Bridge the TTS across terminals 9 and 10 of TB2 and adjust the hybrid balance controls as outlined in procedure (1)(b) above. Compute the attenuation.

(3) Receive Terminal with Two-Wire Termination.

(a) Key the 2700 Hz sender and adjust its gain control for a reading of 0 dBm as indicated on the TTS bridged across terminals 9 and 10 of TB5.

(b) Bridge the TTS across terminals 8 and 16 of J3201 in the CA-1668 or terminals 7 and 8 of J3201 in the FA-5250. Adjust the hybrid balance controls for a minimum reading as outlined in procedure (1)(b) above. Compute the attenuation.

(4) Receive Terminal with Two-Wire External Termination and Four-Wire Internal VFSS Equipment.

(a) Connect a balanced audio oscillator, with a 3000-ohm resistor connected in series with each output terminal, to terminals 11 and 12 of TB5. Adjust the frequency of the audio oscillator to 540 Hz. Adjust the audio oscillator output for 0 dBm as indicated on the TTS connected to terminals 11 and 12 of TB5. (Strap TB2201 terminals 3 and 4 to 1 and 2 respectively on the CA-1668.)

(b) Connect the TTS across terminals 5 and 6 of TB5 and adjust the hybrid balance controls as outlined in procedure (1)(b). Compute the attenuation.

(5) Receive Terminal with Four-Wire External Termination and Four-Wire Internal VFSS Equipment. No hybrid transformer is used when the equipment is connected in this manner.

(6) Receiver Terminal with Four-Wire External Termination and Two-Wire Internal VFSS Equipment.

(a) Connect a balanced audio oscillator, with a 300-ohm resistor connected in series with each output terminal, to J2209 in the CA-1668 or FA-5250. Adjust the frequency of the audio oscillator to 540 Hz. Adjust the audio oscillator output for 0 dBm as indicated on the TTS bridged across the audio oscillator output.

(b) Bridge the TTS across the J2207 and adjust the hybrid balance controls for a minimum reading as outlined in procedure (1)(b). Compute the attenuation.

118.-119. RESERVED.

Subsection 3. CARRIER SIGNALING

120. CA-1703 AND CA-1709 ADJUSTMENT.

a. Object. This procedure adjusts the VFCSS equipment for optimum performance.

b. Discussion.

(1) The am tone senders have two adjustments each, frequency and output level. These adjustments are straightforward and require no special techniques. The sender may be keyed and pulsed locally by the test set while making adjustments.

(2) The am tone receivers have two adjustments each, input gain and receiver bias. The receiver bias control is adjusted for 50-50 mark/space bias measured with the test set while the sender is keyed at the FSS.

(3) The CA-1709 and CA-1703 equipment may be adjusted the same way, but the values measured at the various test points should correspond with their nominal operating values.

c. Test Equipment Required.

(1) TTS.

(2) Test unit and cables furnished with the VFSS equipment.

(3) Electronic frequency counter.

d. Conditions.

(1) Coordinate a maintenance shutdown with the control facility and remove the equipment from service.

(2) Key the am senders locally.

(3) Adjust the monitor am receiver bias as specified.

e. Detailed Procedure.

(1) Sender Frequency Adjustment.

(a) Connect an electronic frequency counter to the output jack of the sender.

(b) Key each sender momentarily and read its frequency on the counter.

(c) If necessary, adjust the fine-tuning control to set the frequency within the limits specified in paragraph 67b.

(2) Sender Levels.

(a) Set up the test equipment as shown in figure 5-10.

(b) Plug a TTS for 600-ohm termination into the send filter-out jack of the am sender to be tested.

(c) If necessary, adjust the sender output level to meet the requirements of paragraph 67a.

(d) Remove the test equipment.

(3) Receiver Adjustments.

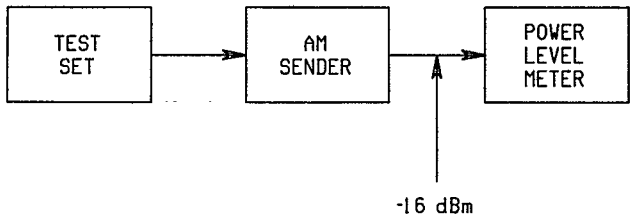


Figure 5-10. VFCSS Sender Adjustment

(a) Set up test equipment as shown in figure 5-11.

(b) Key the corresponding sender at the control point.

(c) Connect a TTS (in the bridge position) to TP1 and adjust the receiver gain control for −27 dBm.

(d) Remove the TTS.

(e) Pulse the sender with the test unit.

(f) Monitor the receiver relay bias distortion with the test unit. Adjust the receiver bias control for 50-50 mark/space bias.

(g) Decrease the input gain to zero; then slowly increase the input gain until the receiver just begins to follow the pulses as indicated by the test unit bias distortion meter. Do not adjust for 50-50 mark/ space ratio.

(h) With the sender keyed, measure the level at TP1. The level should be 10 to 15 dB below the -27 dBm level previously measured in step (c). If correct, reset the gain for −27 dBm at TP1 and continue to step (i).

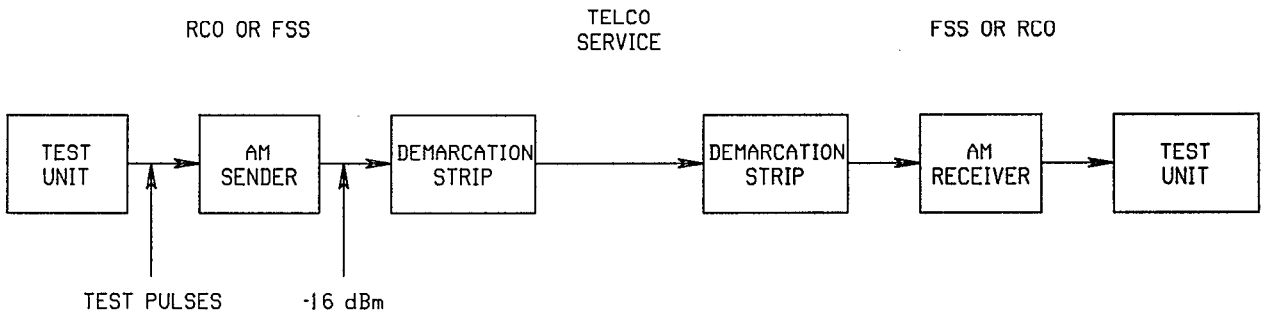


Figure 5-11. VFCSS Receiver Adjustment

(i) Reset the input gain control to −27 dBm plus or minus the required number of dB to bring it within the limits outlined in paragraph 67c. For example, if the TP1 level of the receiver measures only −35 dBm in step (h), the operating range is only 8 dB, therefore, the gain should be increased at least 2 dB.

(j) Repeat this procedure for each am receiver.

(k) Disconnect the test equipment and return the equipment to normal operation.

121.-124. RESERVED.

Subsection 4. TONE SCAN

125. FA-5555 AND FA-5650 ADJUSTMENT.

a. Object. This procedure adjusts the tone equipment of the tone/scan system.

b. Discussion. The single-tone input level to the control line shall be −12 dBm. The detection level of the tone receiver shall be −10 dBm below the input level plus the nominal line loss and seasonal tolerances. This means the am tone receiver input levels will range from −27 dBm to −32 dBm as the lower limits except at 1000 Hz, which is the line initial checkpoint. This checkpoint will have a lower limit of −24 dBm. These adjustment procedures do not, in any way, establish a telco line condition monitoring system.

(1) FS Senders. The fs senders have two controls, balance and output level. The balance control sets the individual mark and space oscillator outputs to the same level. The output level control raises and lowers both mark and space outputs by the same amount.

(2) FS Receivers. The fs receivers have two controls, bias and input gain. The bias control is adjusted to provide a zero distortion output signal whenever a symetrical square wave input signal is present. The input gain control is adjusted to ensure detection of minimum level input signals.

(3) AM Sender. The am sender (single tone) has only an output level control. This control is used to set the output level of the sender.

(4) AM Receiver. The am receiver (single tone) has two controls, bias and input level. The bias control is in effect an automatic gain control (agc) for the receiver. In most configurations of the equipment, this control remains in full clockwise position at all times. The input level control adjusts for detection of a minimum input level.

c. Test Equipment Required.

(1) TTS.

(2) Bias test set.

(3) Oscilloscope.

(4) Electronic frequency counter.

(5) Shorted plug, PL-55 or equal.

(6) Open circuit plug (or plastic dummy plug), PL-55 or equal.

(7) Miscellaneous test leads.

d. Conditions.

(1) Communication between the control and remote site by phone, a spare telco line, and an intercom will be required.

(2) Coordinate with appropriate personnel before taking the system to be checked out of service.

e. Detailed Procedure.

(1) Check the control line at 300 Hz, 1000 Hz, and 3000 Hz; the line must be in tolerance. Refer to the latest edition of Order 6000.22 for requirements.

(2) Output Amplifiers.

(a) For an initial adjustment, set the output level control R1309 to approximately three-fourths of the full clockwise position.

(b) Plug the TTS into the line coupler line 2 equipment jack. Set the TTS to read −12 dBm in a 600-ohm terminated position with a 15 kHz band-pass filter.

(c) Pull both 1500 Hz and 1620 Hz fs senders at the control site.

(d) Key one sender, the midfrequency of all single tone channels, by plugging a shorted phone plug (PL-55) into the input jack.

(e) Adjust the senders output level control R908 for −12 dBm as read on the TTS at line 2 equipment jack.

(f) Reduce the output amplifier output level control R1309 for a −22 dBm reading on the TTS.

(g) If −22 dBm cannot be reached on the TTS, increase the output amplifier output level control and reduce the sender output level control until steps (e) and (f) are met.

(h) Return the output amplifier output level control to read −12 dBm on the TTS at line 2 equipment jack. Refer to paragraph 68g for standards and tolerances.

(3) Am Tone Senders.

(a) Set up the output amplifier as indicated in steps (2)(a) through (2)(h) above.

(b) Plug the TTS into the line coupler line 2 equipment jack with the meter set for 15 kHz filter and 600-ohm terminated positions.

NOTE: To open the keying circuits of the senders, plug an open circuit or a plastic dummy plug into the input jack.

(c) Key each sender one at a time by plugging the shorted phone plug into the input jack, and set output level control R908 for a −12 dBm reading on the TTS. Refer to paragraph 68a for standards and tolerances.

CAUTION: Read only one tone at a time while setting these levels.

(d) After all senders have been set to −12 dBm, reduce the output amplifier to −22 dBm on the TTS. It is now possible to set the receivers' detection levels at either the control or remote sites.

(e) With the output amplifier set to −12 dBm, connect an electronic frequency counter to the line 2 equipment jack and read the frequency of each sender. Refer to paragraph 68b for standards and tolerances.

(4) AM Tone Receivers. With the am senders set up as required in procedure (3) above and the output amplifier set as indicated in step (3)(d) above, proceed as follows:

(a) Establish communications between the control and remote sites.

(b) Coordinate with the technician at the opposite site and determine that steps (3)(a) through (3)(e) have been accomplished.

(c) Set all receiver bias controls R1010 to the fully clockwise positions. This is the final setting.

(d) Set the bias test set function switch to the bias position.

(e) Plug the receiver output jack into the bias test set bias jack with a test cable that has phone plugs on each end.

(f) Have one of the am tone senders keyed. On the corresponding receiver, adjust the input level control R1001 to the point that just provides input signal detection (right full scale reading on the bias test set).

(g) Repeat step (f) until all receivers have been adjusted.

(h) After all receivers have been adjusted, be sure that the control/remote site returns the output amplifier level control R1309 for a −12 dBm level on the line (at line 2 equipment jack). Refer to paragraph 68c for standards and tolerances.

(5) FS Tone Senders.

(a) Coordinate with the control site to be certain that the system is out of service.

(b) Set the TTS for the 600-ohm terminated and 15 kHz filter positions and connect it to the line 2 equipment jack of the online coupler panel.

(c) Alternately key the sender on and off by inserting and removing a shorted phone plug from the input jack of the sender. The balance control R1122 shall be adjusted so that both frequencies, mark and space, are equal in level on the TTS.

(d) Using the TTS as an indicator, adjust output level control R1127 for the level specified in paragraph 68d.

(e) Check that both frequencies on and off, or mark and space, read −12 dBm on the TTS.

(f) Repeat steps (c) and (d) until step (e) is satisfied.

(g) Use a frequency counter and check both frequencies at the output at line 2 equipment jack of the line coupler panel. Refer to paragraph 68e for standards and tolerances.

(6) FS Tone Receivers.

(a) Coordinate with the control site to be certain that the system is out of service.

(b) Set the function switch of the bias test set to the bias position.

(c) Connect the output jack of the receiver to the bias jack of the bias test set.

(d) Establish communication with control site.

(e) Request the control site to key its fs sender at 17.8 dot/cycles with its bias test set.

(f) Adjust the bias control R1221 of the receiver for a zero bias indication on the bias test set meter.

NOTE: If zero bias cannot be reached by adjusting the bias potentiometer, repeat step (5) above.

(g) Set the control site output amplifier to −22 dBm at line 2 equipment jack as described in step (3)(d) above.

NOTE: The control site must remove the TTS from the line 2 equipment jack before the signal can be received at the remote site.

(g) Set the control site output amplifier to −22 dBm at line 2 equipment jack as described in step (3)(d) above.

NOTE: The control site must remove the TTS from the line 2 equipment jack before the signal can be received at the remote site.

(h) Request the control site to key the fs sender by plugging a shorted phone plug into the input jack.

(i) Adjust the fs receiver input level control R1207 to the point that just provides input signal detection (right full scale reading on the bias test set). Refer to paragraph 68f for standards and tolerances.

(j) Repeat steps (c) through (i) for the other fs channel.

(k) Set the TTS to 600-ohm terminated and plug it into the line 2 equipment jack. Adjust the output amplifier back to −12 dBm on the TTS.

(l) Remove the TTS from the line coupler panel.

126.-129. RESERVED.

Subsection 5. IN-BAND SINGLE FREQUENCY

130. VEGA ADJUSTMENT.

a. Object. This procedure adjusts modules of the Vega in-band tone signaling equipment.

b. Discussion. Because the Vega installation may vary from one region to another, this procedure describes a typical configuration: encoder-amplifier-line-bandpass/notch filter-decoder. The alignment of the control and remote terminal is accomplished on an individual basis, rather than on an end-to-end basis, to preclude any coordination problems between control and remote sites.

c. Test Equipment Required.

(1) TTS.

(2) Electronic frequency counter.

(3) Vtvm.

(4) Audio oscillator or function generator.

(5) 16 dB pad.

d. Conditions. Coordinate a maintenance shutdown with the control facility and remove the equipment from service.

e. Detailed Procedure.

(1) Control Terminal.

(a) Encoder Output Level. Set model 310 encoder gain, R13, at midrange. While keying encoder, adjust model 312 tone amplifier gain, R12, the level indicated in paragraph 69a.

(b) Audio Amplifier Output Level. With a 0 dBm, 1000 Hz input, adjust the transmit audio amplifier gain, R12, for 0 dBm measured with the TTS at the bridging jack (unity gain).

(c) Encoder Frequency. Using an electronic frequency counter, measure the model 310 encoder frequency at the bridging jack. If the frequency is not within the limits specified in paragraph 69b, remove the plastic filter from the center of coil L1 and adjust the slug to specified frequency. Refill the slug with RTV silicone rubber or equivalent.

(2) Remote Terminal.

(a) Decoder Sensitivity. Insert a −32 dBm tone of the specified frequency at the equipment jack. Adjust ac voltage measured at TP2 of Model 341 decoder with R13 of the Model 345 bandpass/notch filter for a maximum reading. Then adjust R32 of the model 341 decoder until the relay drops out. Record the voltage. Adjust R32 of the model 341 decoder to a voltage 10 times that recorded at relay dropout. The decoder now has a 20 dB sensitivity. Refer to paragraph 69c for standards and tolerances.

NOTE: A 16 dB pad may be required to achieve a −32 dB level from the audio oscillator.

(b) Notch Output Level (Audio). Insert a −16 dBm 1000 Hz tone at the equipment jack. Adjust R12 (notch output) of the model 345 band-pass/notch filter for −16 dBm (unity gain) measured at audio output to radio transmitter.

(c) When maintenance is complete, and operation is satisfactory, return the SFO to service and notify the control facility.

131.-134. RESERVED.

Subsection 6. DATA ABOVE VOICE

135. LCT-CNTR-1A AND RCT-RCAG-1A ADJUSTMENT.

a. Object. This procedure adjusts the LCT-CNTR-1A and RCT-RCAG-1A tone control equipment.

b. Discussion. The local and remote terminals are adjusted in similar manner except the remote terminal has additional modules. This equipment is designed to work with a variety of voice grade lines. The national standard has now been established as a zero loss line (ZL^2). During the interim period required for an orderly change over to the national standard, Chapter 3, Standards and Tolerances and associated maintenance procedures in this chapter will include guidance for existing leased lines used with this equipment.

c. Test Equipment Required.

(1) Transmission test set (TTS).

(2) Audio oscillator or function generator.

(3) Pad, 600-ohm to 600-ohm, 9 dB or 16 dB.

d. Conditions.

(1) Coordinate a shut down of the RCAG channel for maintenance.

(2) In the following procedure, the audio path is aligned first. Then the fsk levels are adjusted. This procedure provides guidance for adjustment of the local and remote terminals independent of each other.

e. Detailed Procedure.

(1) Local Terminal Transmit Path. (Refer to figure 5-12.)

(a) Place the line interface module (LIM) on an extender card and plug it into the card cage.

(b) Insert a terminating plug into the RX SP LINE jack (J4).

(c) Apply a 1000 Hz sinewave at the level specified in paragraph 70a(1)(a), 600-ohm output, to the LIM via the TX SP EQ jack (J1). Insert a terminating plug into the TX AGG EQ jack to break the path to the telco line.

(d) Monitor the output of U1A at R3. Ground is obtained at TP2. Use the "BRIDGED" setting on the test unit.

(e) Adjust R2 for −10 dBm at R3. Adjust R34 maximum counterclockwise (ccw) if the order wire is not used.

(f) Remove the 1000 Hz test tone. Remove the terminating plug from the TX AGG EQ jack and connect the test unit to the TX AGG EQ jack (J2).

(g) Reinject the 1000 Hz tone in accordance with (c) above. Adjust TX LEVEL (R5) on the front of the LIM for 0.5 dBm higher than the value specified in paragraph 70a(1)(b), TX AGG EQ jack, J2. The output to the line will then be the level specified in paragraph 70a(1)(b).

(h) Remove the 1000 Hz sinewave source.

(i) Monitor the fsk tone input to the LIM card at R10. Use "BRIDGED" setting on test equipment.

(j) Adjust the TX LEVEL (R9) on the front of the MFS 2880 fsk module for the level specified in paragraph 70a(1)(c) at the monitor point in step (i).

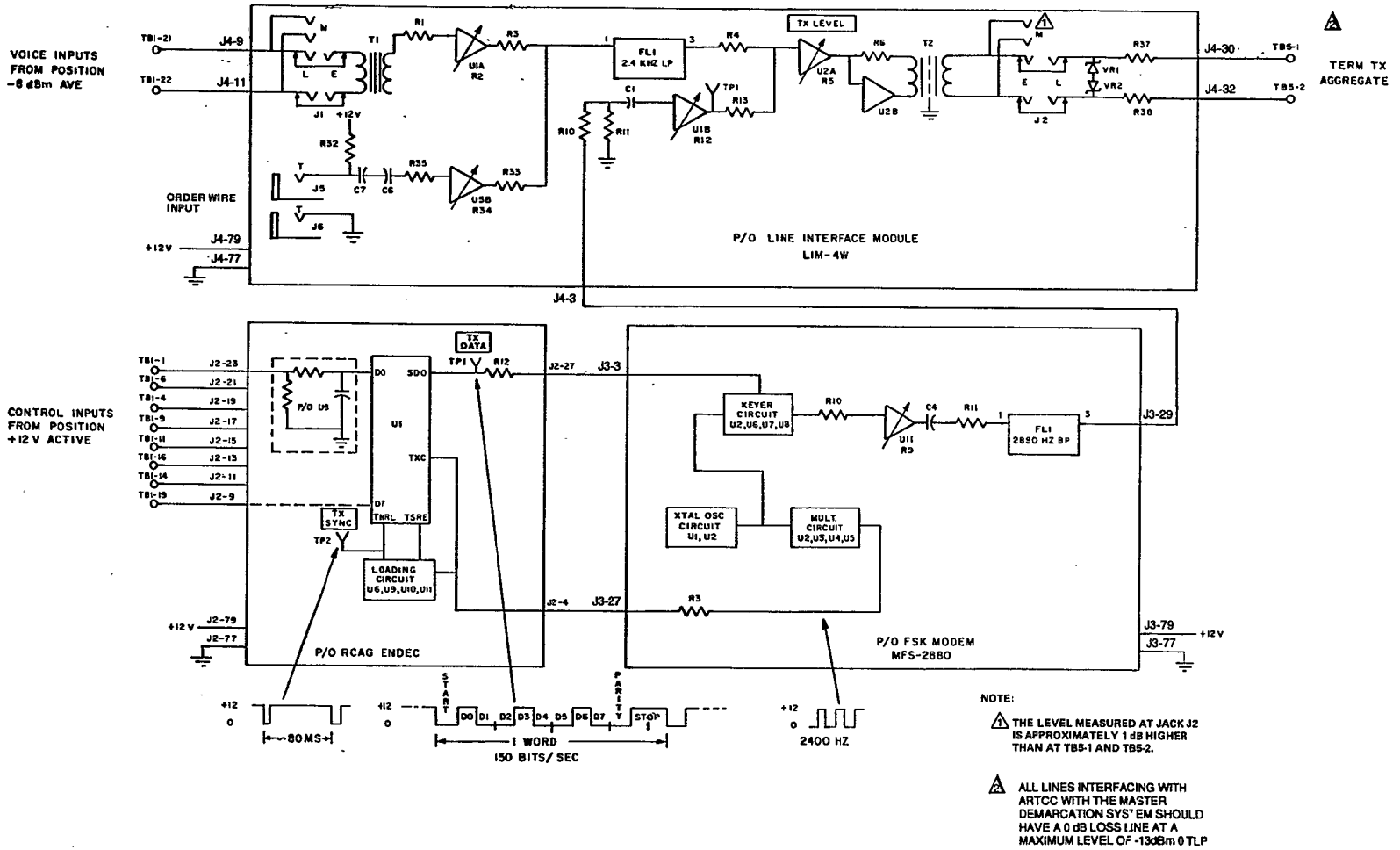


Figure 5-12. Block Diagram, Local Terminal Transmit Path Line Interface Module (LIM-4W)

(k) Monitor the fsk tone output at the TX AGG EQ jack, J2.

(l) Adjust R12 on the LIM for 1 dBm higher than the value specified in paragraph 70a(1)(d).

NOTE: The internal tone/voice level ratios are now correct on the local unit LIM card. No further adjustments should be made to R2 on the LIM or R9 on the fsk modem, local unit. If periodic level adjustments are necessary to compensate for line changes, only R5 on the LIM should be adjusted.

(2) Local Terminal Receive Path. (Refer to figure 5-13.)

NOTE: Use caution to avoid allowing test tones to enter the line amplifier input. Insert a terminating plug into the RX SP EQ jack (J4) before injecting tones.

(a) With an extender card, insert the LIM into the card cage.

(b) Inject a 1000 Hz tone in the RX AGG EQ jack at the level specified in paragraph 70a(2)(a).

(c) Monitor the output of U3 on the left end of R17 on the LIM.

(d) Adjust R16, RX LEVEL, on the front panel for −10 dBm at the monitored point. Adjust R29 maximum ccw if the order wire is not used.

(e) Temporarily remove the test tone and connect the meter to the RX SP EQ jack (J4).

(f) Reinsert the test tone and adjust R19 to the value specified in paragraph 70a(2)(c) on the test set.

(g) Remove the 1000 Hz signal from the LIM, allowing the fsk from the remote site into the unit. If a remote site signal is not available, jumper the TX AGG EQ jack to the RX AGG EQ jack.

(h) Monitor the fsk signal at TP3 on the LIM. Adjust R23 for a level of −20 dBm on the test set. This assures that the proper level can be reached. If the desired signal level can not be reached, a slight readjustment of RX level, R16 may be required. If RX LEVEL is changed, repeat steps (e) and (f) before continuing.

(i) Readjust R23 for the level specified in paragraph 70a(2)(d) at TP3.

(j) Readjust RX LEVEL, R15, on the MFS 2880 fsk modem front panel until the TONE ALARM indicator begins to flash. The alarm level should be as specified in paragraph 70a(2)(f).

(k) Readjust R23 for −20 dBm at TP3. This adjustment sets the alarm point.

(3) Remote Terminal Transmit Path. (Refer to figures 5-14, 5-15, and 5-16.)

(a) Inject a 1000 Hz signal at the level specified in paragraph 70b(1)(a) into the RX MAIN EQ, FREQ A (J3) or RX STDBY EQ, FREQ A (J4) jack on the Radio Interface Patch Module (RIPM). The MAIN or STDBY jack used for the adjustment must be the one selected by the control system.

(b) Place the RIM-200 radio interface module on the card extender. Adjust R18 in the RIM for a test tone level of −5 dBm at the output of U2B (left side of C3).

* (c) At the RIPM, inject 1000 Hz at the level specified in paragraph 70b(1)(a) into the RX MAIN EQ, FREQ B (J8) or RX STDBY EQ, FREQ B (J9) jack. Adjust R51 in the RIM for as close as possible to −5 dBm at the output of U5B (left side of C9).

(d) Place the LIM-4W module on the extender card and adjust R2 in the LIM (GND at TP2) for −10 dBm at the output of U1A. (The signal is present at the left side of R3, which is hidden from view by the upper filter.)

(e) Adjust R5 for an audio output at the TX AGG MON jack of 0.5 dBm more than the level specified in paragraph 70b(1)(b).

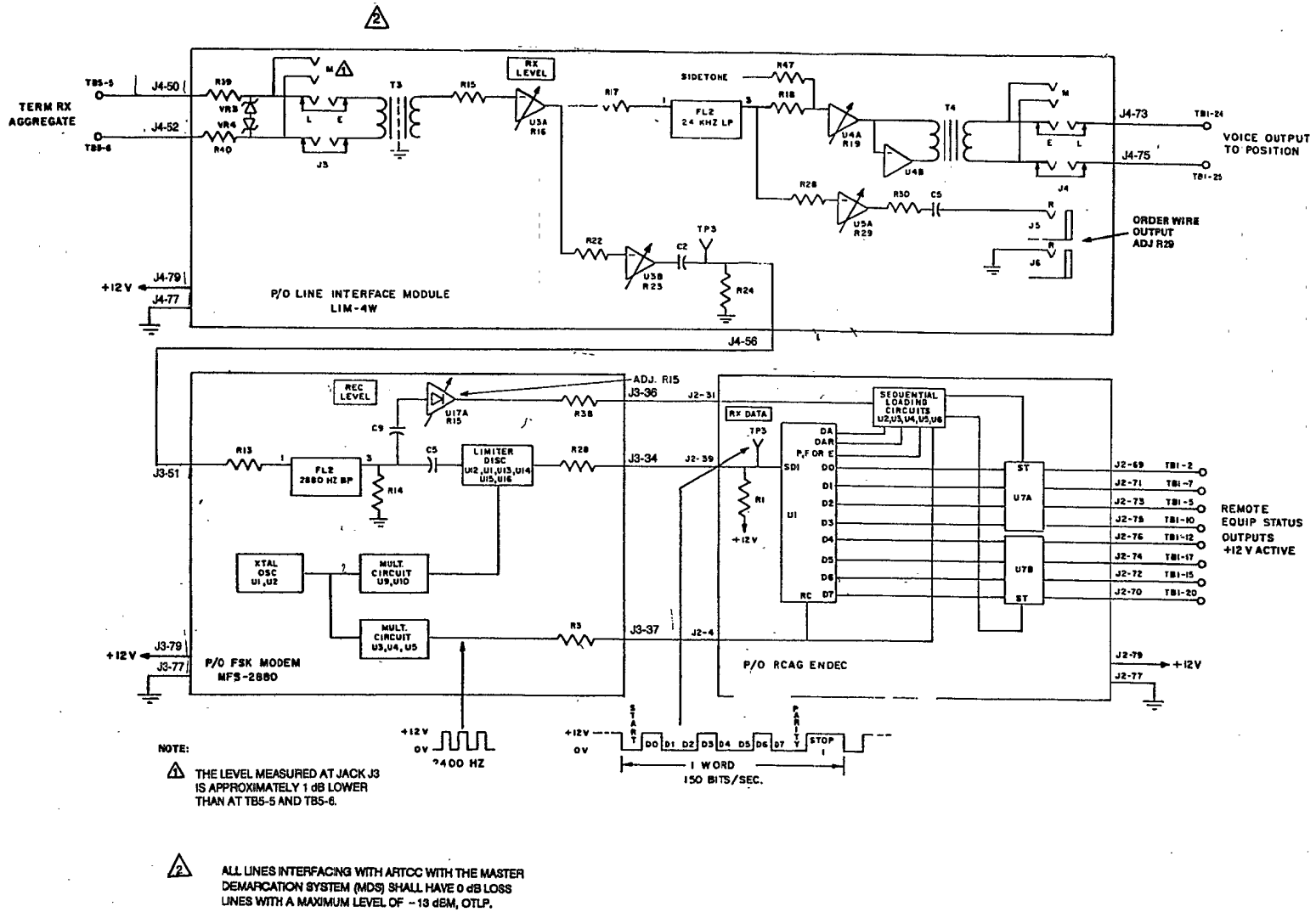


Figure 5-13. Block Diagram, Local Terminal Receive Path Line Interface Module (LIM-4W)

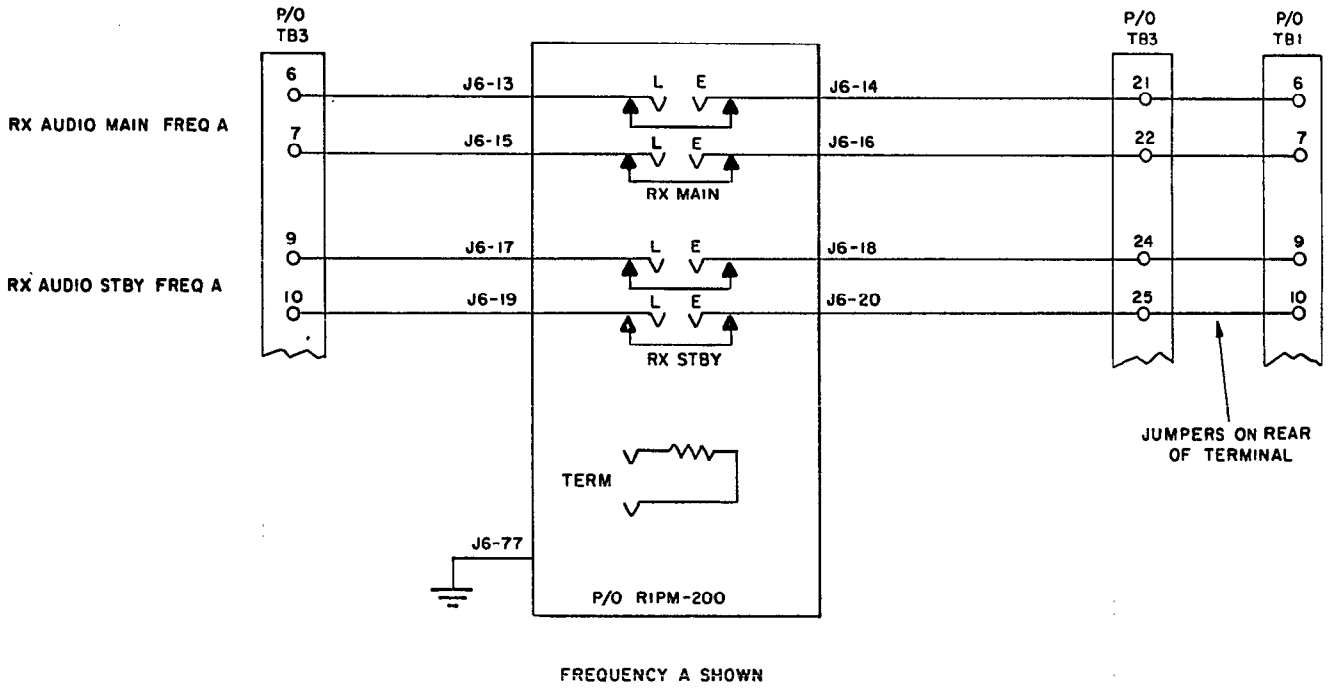


Figure 5-14. Block Diagram, Remote Terminal Transmit Path Radio Interface Patch Module

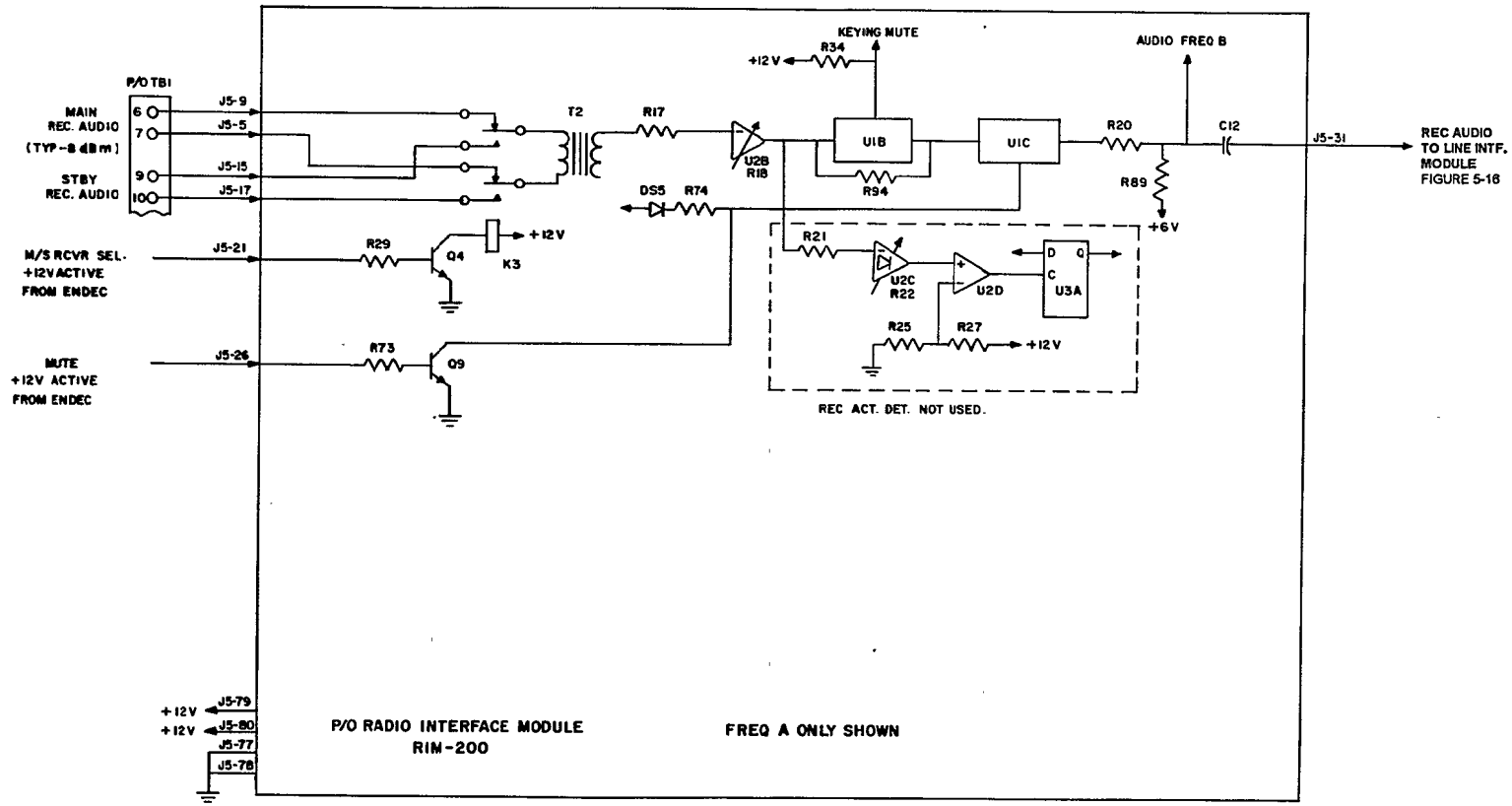


Figure 5-15. Block Diagram, Remote Terminal Transmit Path Radio Interface Module (RIM-200)

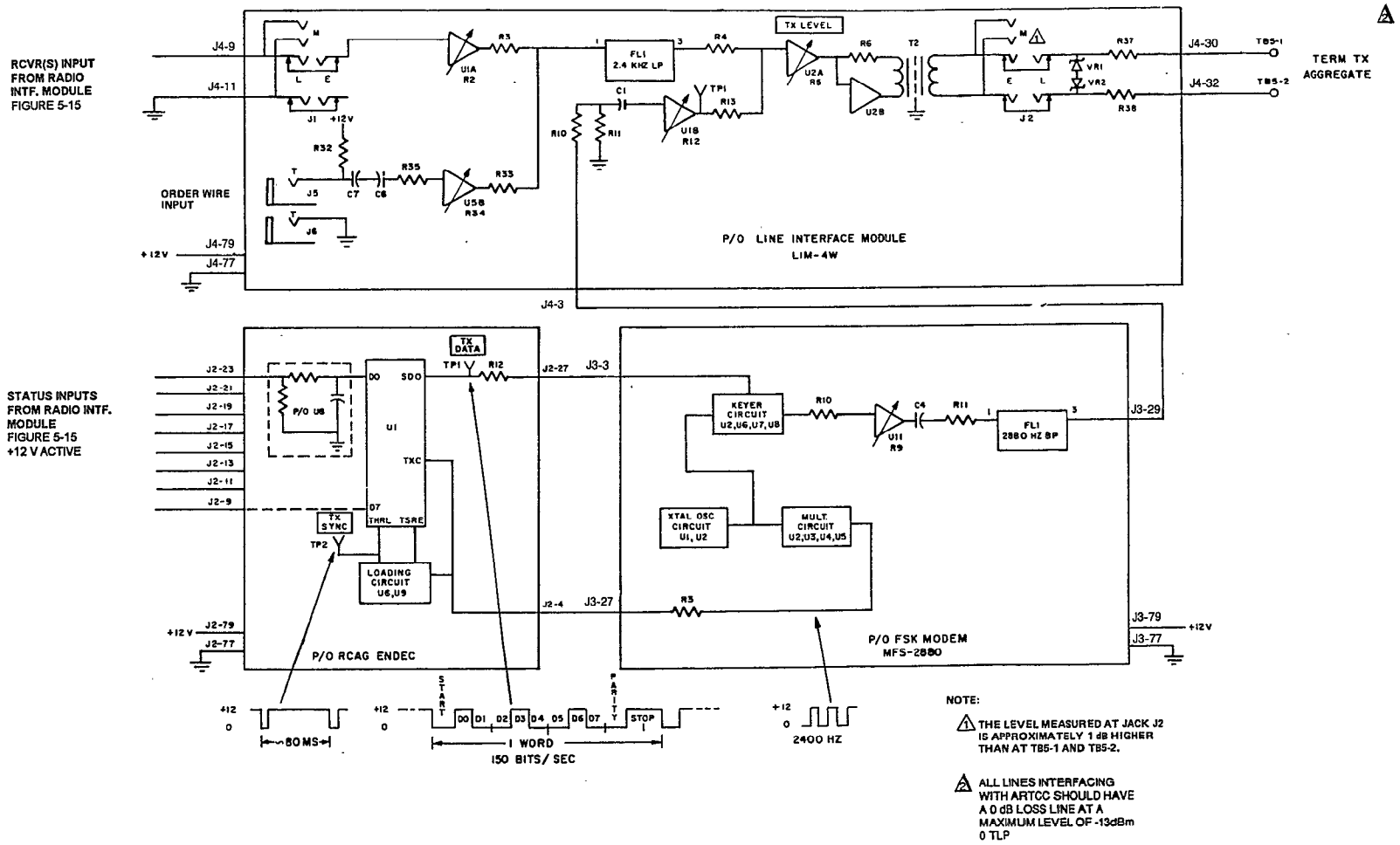


Figure 5-16. Block Diagram, Remote Terminal Transmit Path Line Interface Module (LIM-4W)

(f) Remove the 1000 Hz tone. Monitor (bridged) the FSK tone input to the LIM card at the bottom of R10. Adjust the TX level (R9) on the front of the MFS-2880 modem module for the level specified in paragraph 70b(1)(c) at the input to the LIM.

(g) Adjust R12 in the LIM for an FSK output signal level as specified in paragraph 70b(1)(d) at the TX AGG MON jack of the LIM.

NOTE: As a precaution, before returning the equipment to service, verify that the signals in step (a) and (c) for the alternate equipment (MAIN or STANDBY) operation is satisfactory by having personnel at the control site switch equipment and conduct a test modulation check.

(4) Remote Terminal Receive Path. (Refer to figures 5-17, 5-18, and 5-19.)

(a) Place the LIM module on the card extender and inject 1000 Hz at the level specified in paragraph 70b(2)(a) into the RX AGG EQ (J3) jack.

(b) Monitor (bridged) at the left end of R17 and adjust R16, RX LEVEL, on the front panel for −10 dBm at the output of U3A. Adjust R29 maximum ccw if the order wire is not used.

(c) Measure the level at RX SP EQ (J4) with test unit in "TERMINATE" position. Adjust R19 for the signal level input specified in paragraph 70b(2)(c). Remove LIM card from extender.

(d) Place all of the transmitters in local control for the channel under alignment. Place the ENDEC module on the card extender and jumper pin 69 (6th strip up from the bottom of the card -- the back side has odd number strips) to the +12 volt test point on the power supply module.

(e) Measure the signal level (terminated) at the TX MAIN EQ, FREQ A (J1) jack on the RIPM-200 Radio Interface Patch Module. Adjust R5, TX LEVEL, FREQ A, on the RIM front panel for a level specified in paragraph 70b(2)(d).

(f) Move the +12-volt jumper to pin 71 on the card-extended ENDEC.

(g) Measure the signal level at the TX MAIN EQ, FREQ B (J6), on the RIPM and adjust R39, TX LEVEL, FREQ B, on the RIM front panel for the level specified in paragraph 70b(2)(d) to the transmitter.

(h) Reinstall the ENDEC and place the LIM-4W module on the card extender.

(i) Remove the test tone allowing the FSK from the control site to come through. (If the remote site signal is not available, jumper the TX AGG EQ jack to the RX AGG EQ jack. This provides an FSK signal as though it were being received from the remote site.)

(j) Monitor the signal (bridged) at TP3 on the LIM front panel and adjust R23 in the LIM for as close as possible to −20 dBm at TP3.

(k) Readjust R23 for the level specified in paragraph 70b(2)(e).

(l) Adjust R15, RX LEVEL, on the modem front panel until the TONE ALARM indicator begins to flash. The alarm level should be as specified in paragraph 70b(2)(g).

(m) Readjust R23 in the LIM for as close as possible to −20 dBm at TP3.

(n) Leave the transmitters in LOCAL and have the ARTCC technician make a test modulation check to verify all outbound audio level adjustments. Both MAIN and STDBY equipment must be checked. Return the transmitters to REMOTE before returning the channel to ATC service.

136. INTELECT 3130A ADJUSTMENT.

a. Object. This procedure adjusts the Intelect 3130A VFSS.

b. Discussion. The basic single frequency unit is composed of a model 5134 local channel controller (CC),

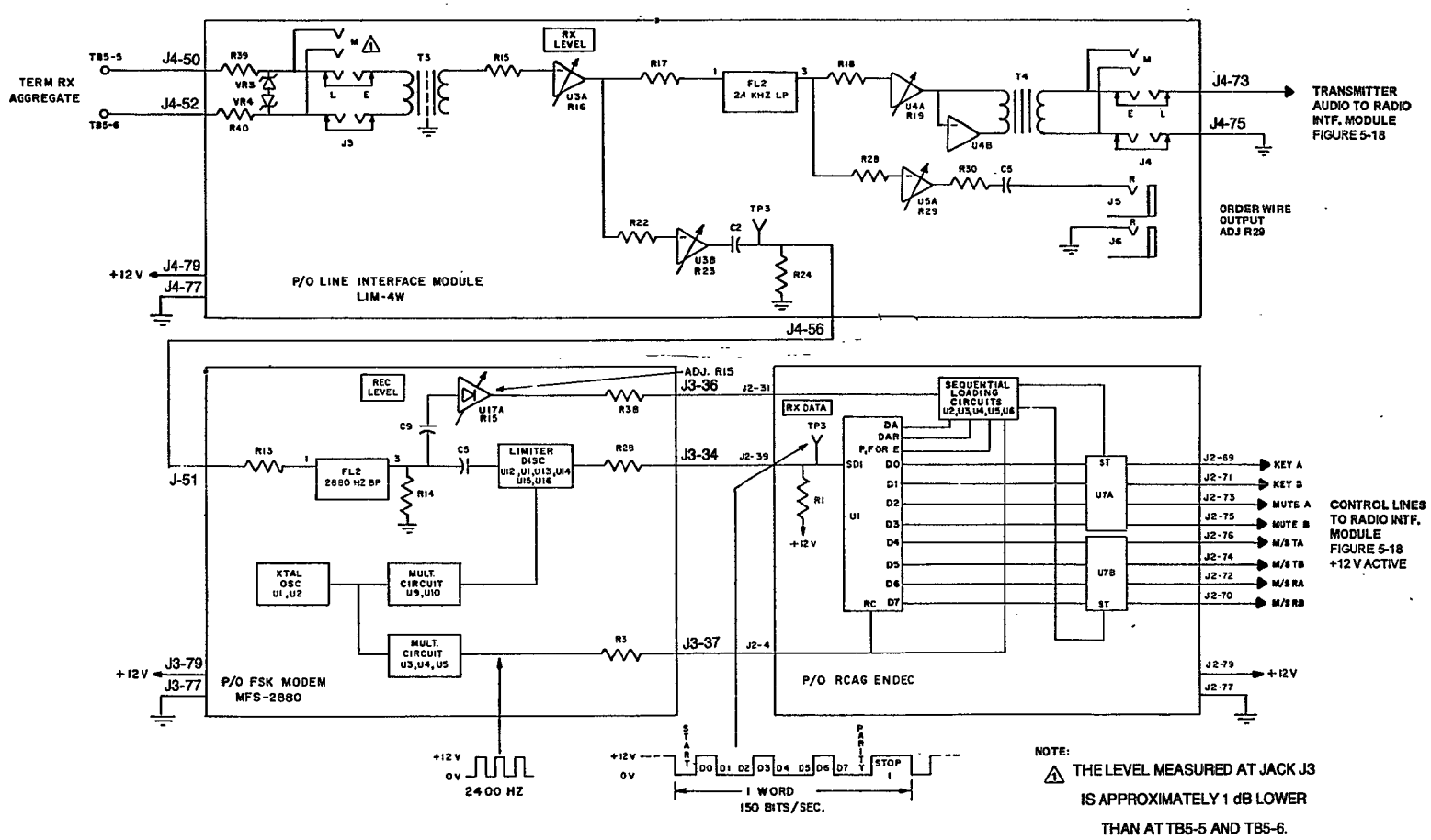


Figure 5-17. Block Diagram, Remote Terminal Receive Path Line Interface Module (LIM-4W)

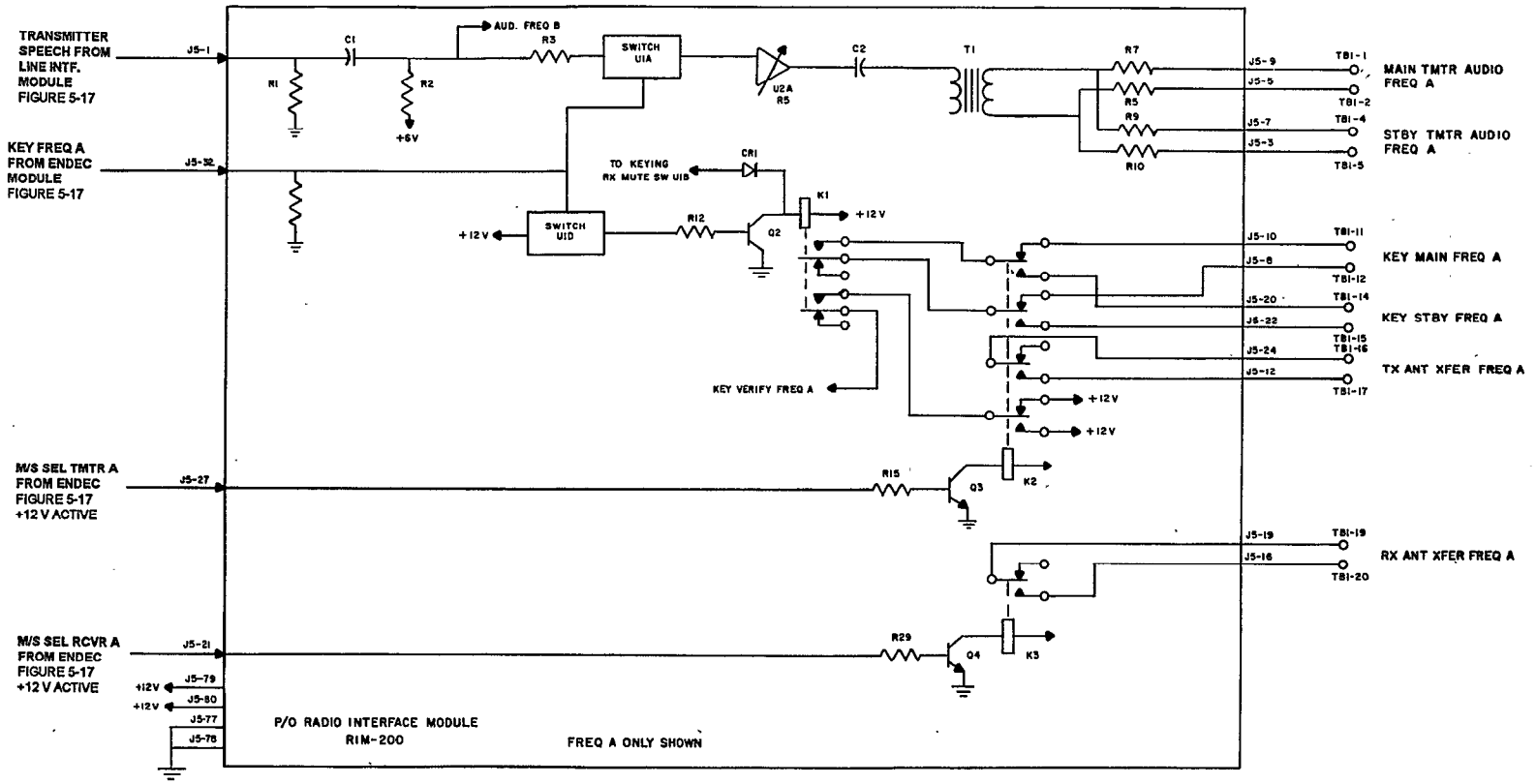


Figure 5-18. Block Diagram, Remote Terminal Receive Path Radio Interface Module (RIM-200)

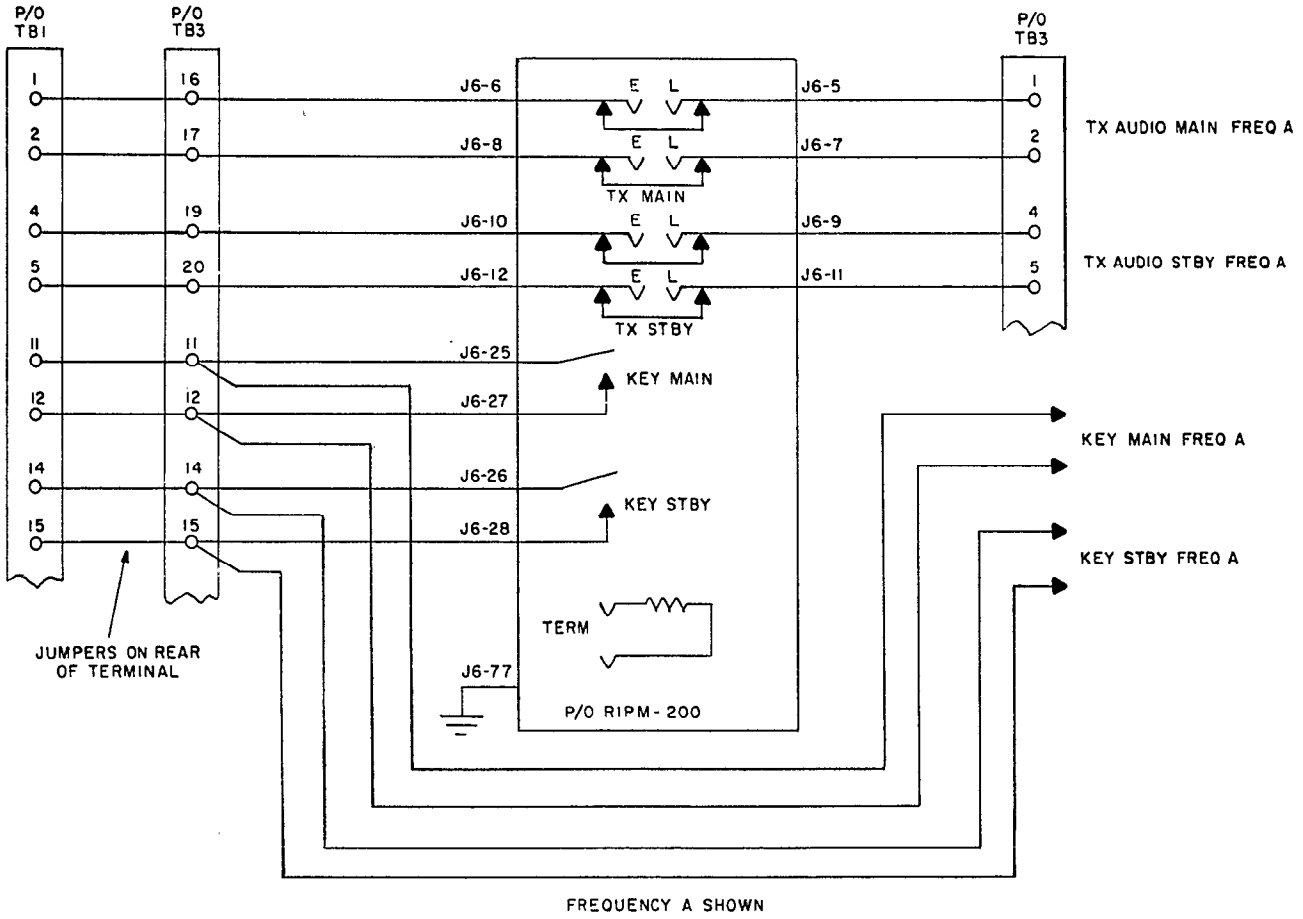


Figure 5-19. Block Diagram, Remote Terminal Receive Path Radio Interface Patch Module

a model 5130B data above voice (DAV) module and power supply at the local site. The remote site uses a 5130B DAV module, a 5135A remote channel controller, and a power supply. The procedure allows the local and remote site equipment to be adjusted independently of each other.

c. Test Equipment Required.

(1) Transmission test set (TTS) or transmission measuring set (TMS).

(2) Terminating bantam jack plug.

(3) WE310 patch cord, ITT Pomona bantam plug 4280-60 or equivalent.

d. Conditions.

(1) Coordinate a shutdown of the communications channel for maintenance.

(2) While the procedure provides guidance for alignment of the local and remote equipment independently, the final check in every alignment procedure is a channel voice modulation check conducted by an operator at the control end.

(3) This procedure aligns the voice levels before the fsk adjustments are finalized.

e. Detailed Procedure.

(1) Local Terminal Transmit Path. (See figure 5-20.)

(a) On the 5130B printed circuit assembly (PCA), place the FSK switch to the OFF position.

(b) Connect the test set XMT section to the XMT DROP jack on the module front panel.

(c) Connect the test set RCV section to the XMT LINE jack. Set the test set receive section to the TERMINATE mode.

(d) Inject a 1000 Hz test tone into the XMT DROP jack at the level specified in paragraph 71a(1)(a).

(e) Adjust the front panel XMT VF control for the level specified in paragraph 71a(1)(b).

(f) Remove the test signal but keep a jack plugged into the XMT drop jack to prevent any signal from entering the 5130B DAV unit.

(g) Place the FSK switch on the 5130B module to the ON position.

(h) Adjust the front panel TONE control for the level specified in paragraph 71a(1)(c).

(i) Remove test cables and jacks.

(2) Local Terminal Receive Path. (See figure 5-21.)

(a) Connect the test set transmit section to the 5130B module RCV LINE jack.

(b) Insert a plug into the RCV DROP jack to prevent test tones from being coupled to the line amplifier input.

(c) Set the test set receive section to the BRIDGE mode and connect it to the RCV MON jack.

(d) Turn the equalization control EQL, R73, to its full counter clockwise (ccw) position. (R73 is a twenty turn potentiometer.)

(e) Turn the VOX THRESHOLD potentiometer (R8) to its full ccw position. This disables the VOX detector.

(f) Inject a 1000 Hz test tone signal into the RCV LINE jack at the level specified in paragraph 71a(2)(a).

(g) Adjust the front panel GAIN control (R72) for an indication of −6 dBm.

(h) Temporarily remove the test tone from the RCV line jack.

(i) Remove the plug from the RCV MON jack and insert it into the RCV DROP jack.

(j) Reinsert the test tone in the RCV LINE jack.

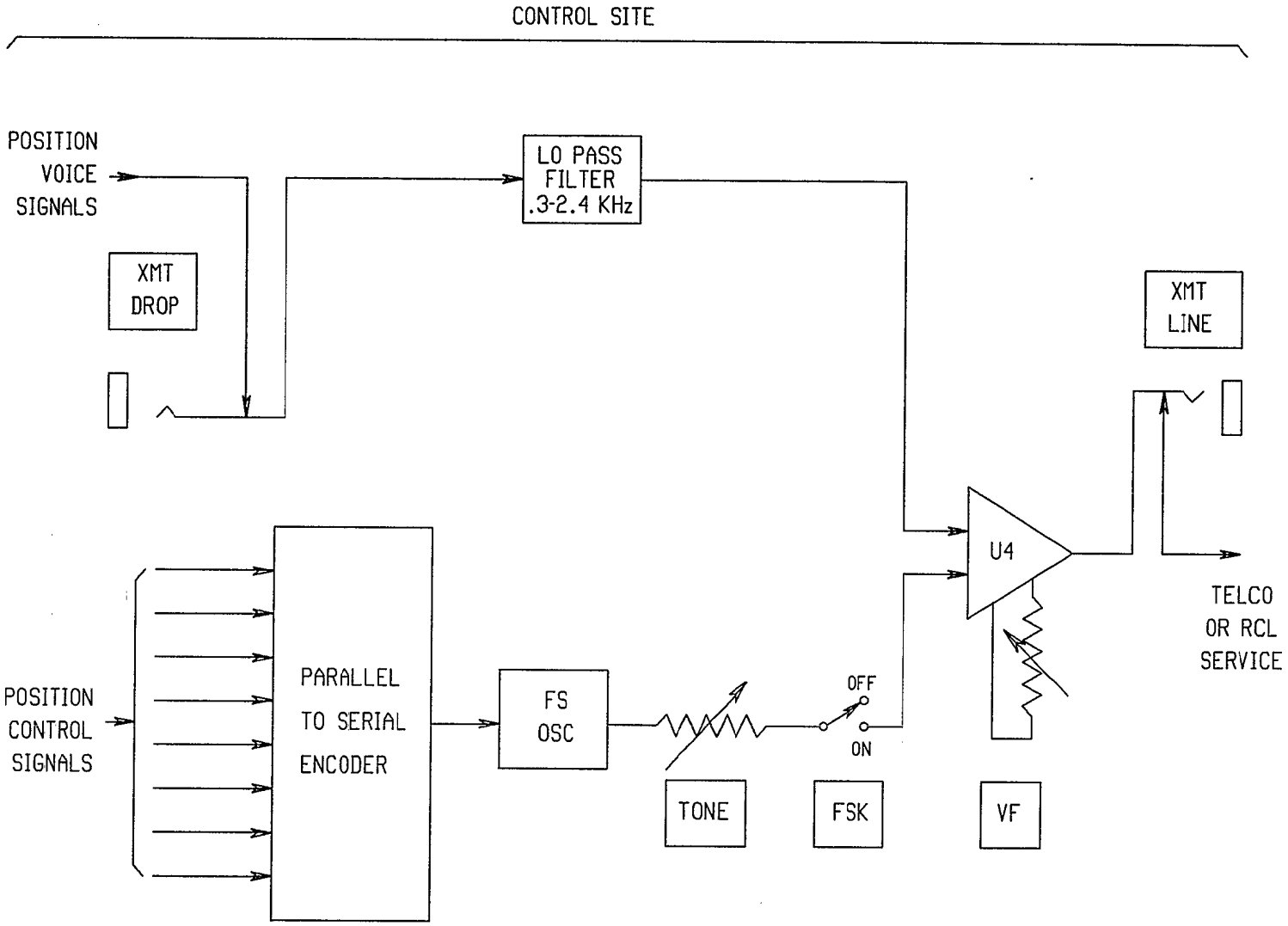


Figure 5-20. Block Diagram, Intelect Local Terminal Transmit Path

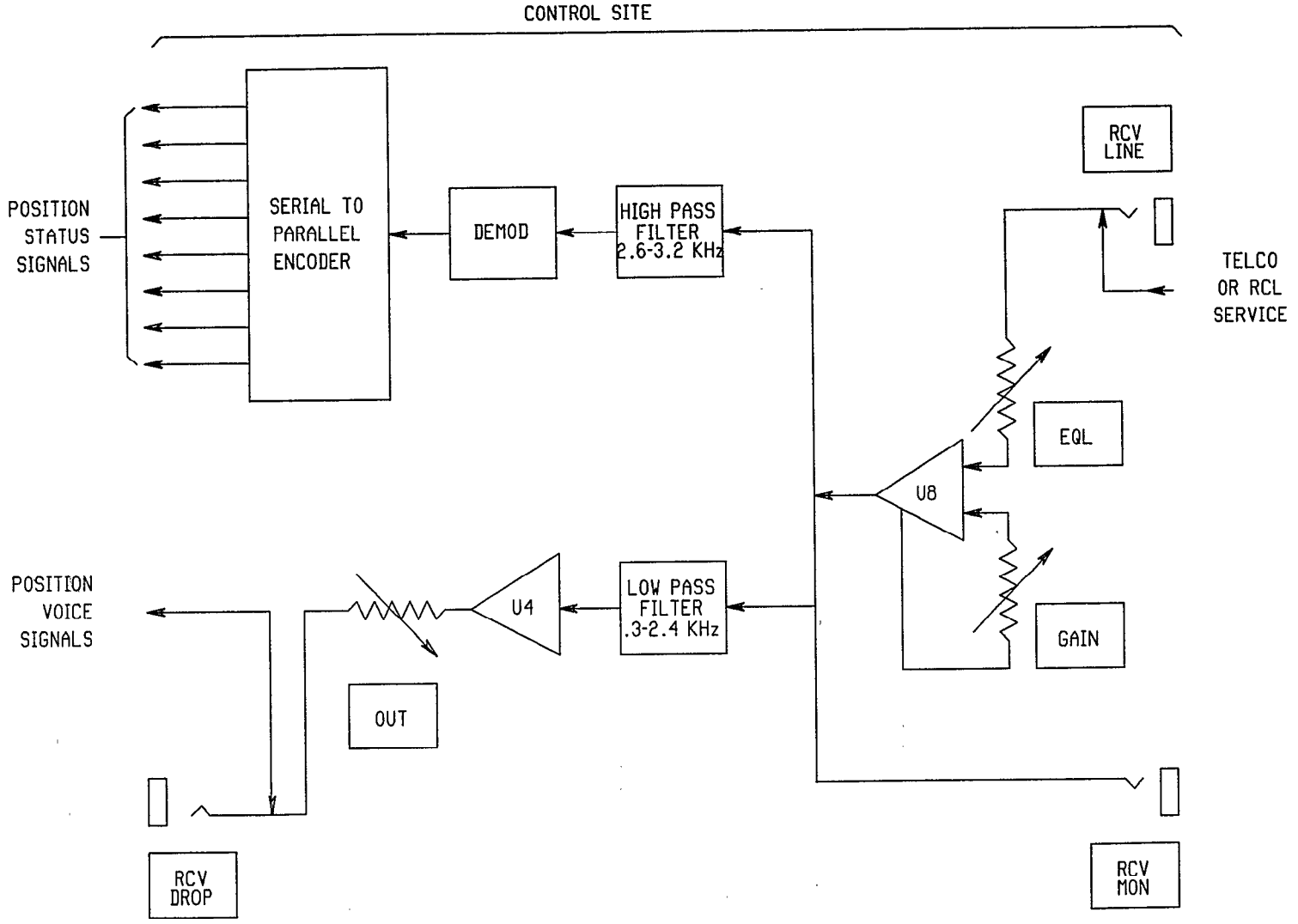


Figure 5-21. Block Diagram, Intelect Local Terminal Receive Path

(k) Set the test set receive section to the TERMINATE position.

(l) Adjust the OUT control (R94) for the level specified in paragraph 71a(2)(b).

(m) Remove all test equipment and plugs.

(n) Conduct channel voice modulation check. Both main and standby equipment must be checked.

(3) Remote Terminal Receive Path. (See figure 5-22.)

(a) Turn EQ control (R72) fully ccw (R72 is a 20 turn potentiometer).

(b) Inject a 1000 Hz test tone at the level specified in paragraph 71b(1)(a) into the 5130B RCV LINE jack.

(c) Connect the test set to the RCV MON jack and adjust the GAIN control (R72) for −6 dBm signal level.

(d) Move the test unit input plug to the RCV drop jack, terminated position.

(e) Adjust the OUT control (R94) for a signal level of −6 dBm. If this level cannot be reached, readjust the GAIN control slightly to allow the adjustment to be made.

(f) Move the test unit input to the V-XMTR jack on the 5135A unit. Adjust the V-XMTR control (R107) for the level specified in paragraph 71b(1)(c).

(g) Move the test unit input to the U-XMTR jack on the 5135A unit. Adjust the U-XMTR control (R108) for the level specified in paragraph 71b(1)(c).

(h) Remove the test unit cable connections.

(i) Restore the equipment to normal.

(4) Remote Terminal Transmit Path. (See figure 5-23.)

(a) Set the FSK switch (S1) to the OFF position.

(b) Inject a 1000 Hz test tone at −6 dBm into the XMT-DROP jack on the 5130B unit.

(c) Connect the test unit input to the XMT LINE jack on the 5130B unit.

(d) Adjust the VF control (R6) for the level specified in paragraph 71b(2)(d).

(e) Move the 1000 Hz test tone signal from the XMT DROP jack on the 5130B to the V-RCVR jack on the 5135A unit.

(f) Adjust the test tone input to the V-RCVR jack to the level specified in paragraph 71b(2)(a).

(g) Adjust the V-RCVR control (R60) for the same test unit reading obtained in step (d) above.

(h) Move the test tone to the U-RCVR jack on the 5135A unit and adjust U-RCVR control for the same test unit reading obtained in step (d) and (g) above.

(i) Set the FSK switch (S1) to the ON position.

(j) Remove the test tone from the 5135A unit jack.

(k) Adjust the TONE control (R7) for a FSK signal at the level specified in paragraph 71b(2)(e).

(l) Remove all cables and test equipment.

(m) Conduct channel voice modulation check. Both main and standby equipment should be checked.

(n) When maintenance is complete and operation is satisfactory, return the equipment to service and notify the control facility.

137. LCT-SFO-1 AND -2 AND RCT-SFO-1 AND -2 ADJUSTMENT.

a. Object. This procedure describes a method to adjust the LCT-SFO-1 and -2 and RCT-SFO-1 and -2 equpiment.

b. Discussion. This procedure provides a method of alignment of individual local and remote terminals. This approach allows for adjustment of units without

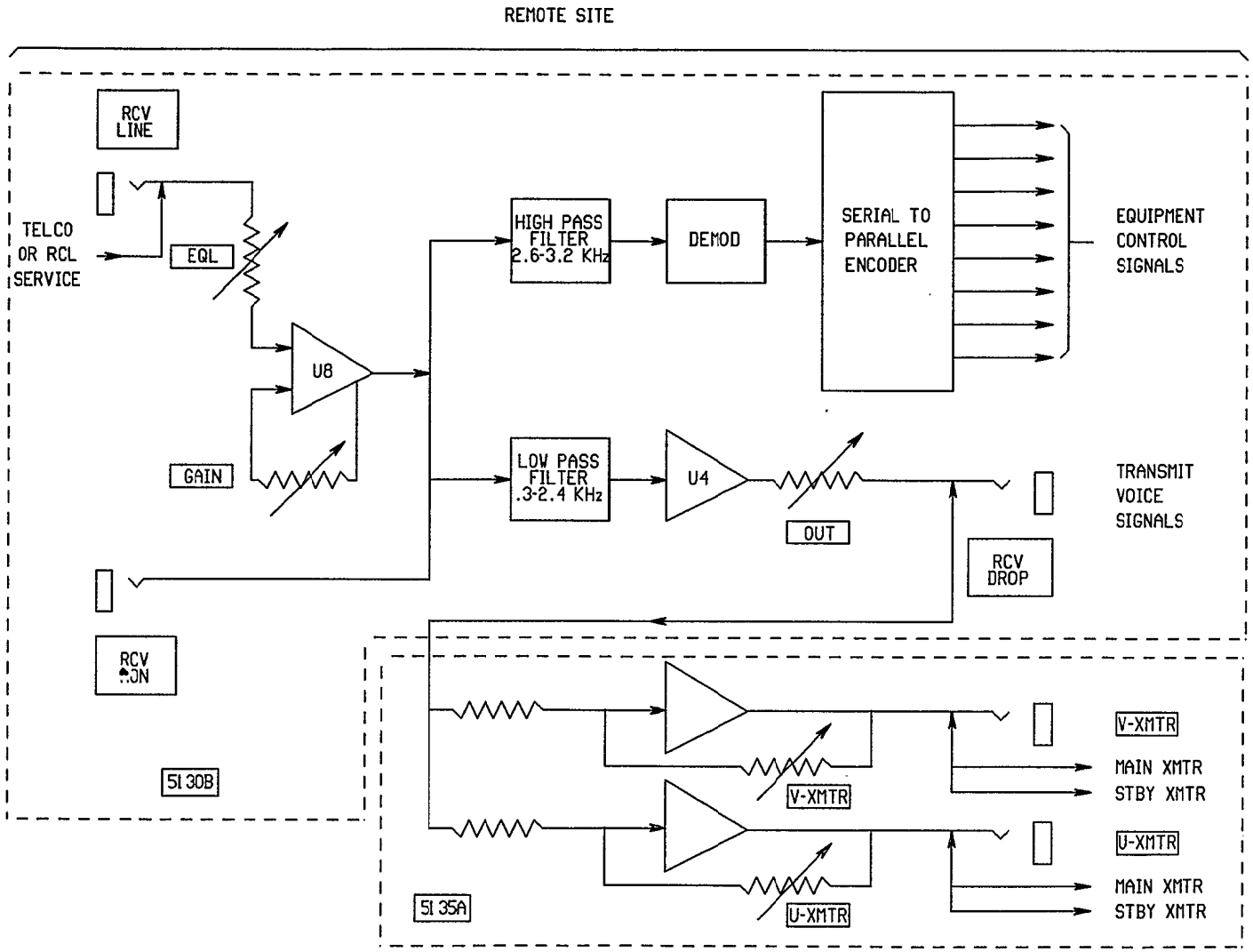


Figure 5-22. Block Diagram, Intelect Remote Terminal Receive Path

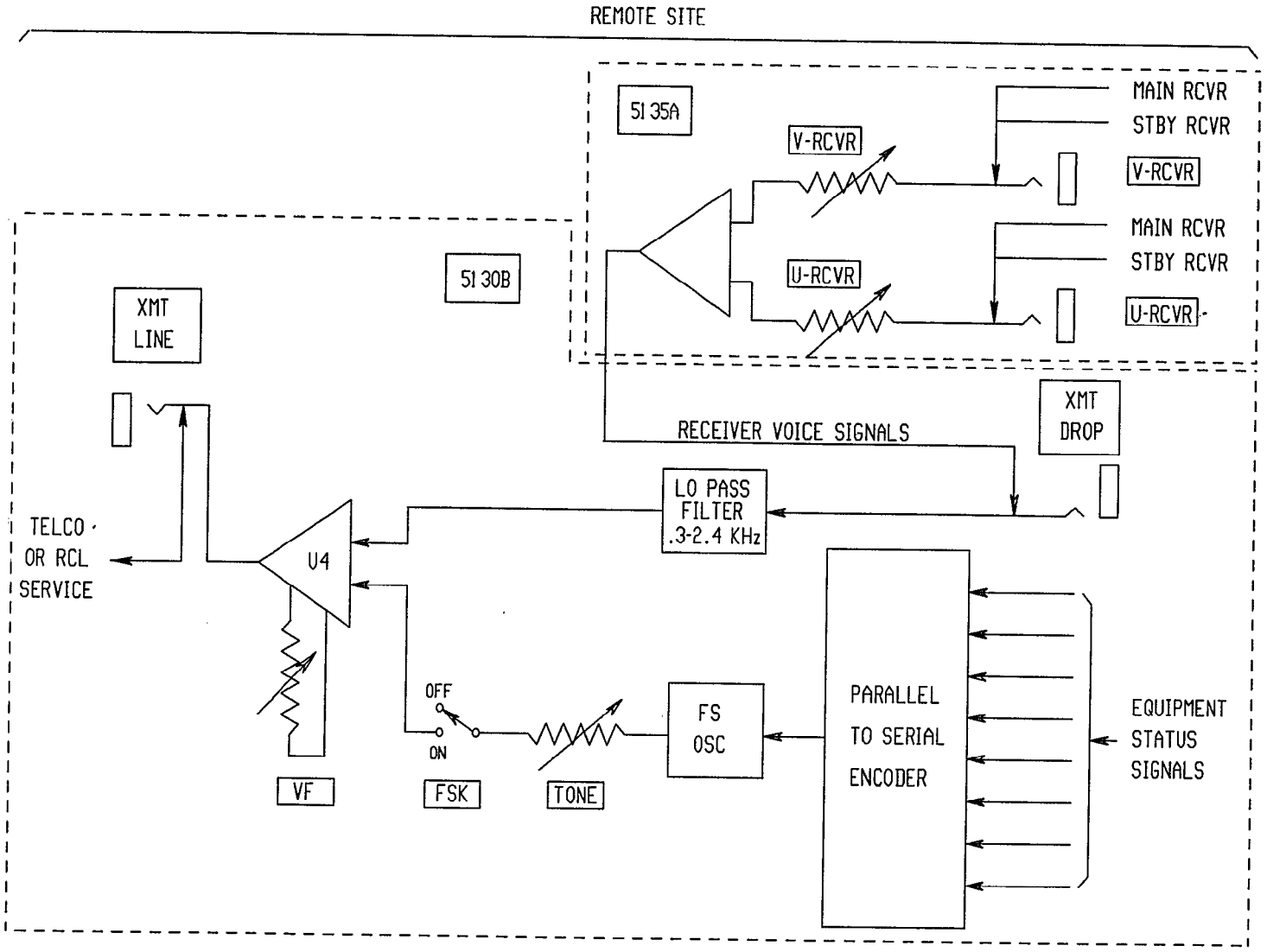


Figure 5-23. Block Diagram, Intelect Remote Terminal Transmit Path

having personnel at each site. The final step in the procedure requires a voice modulation check of the total system to assure proper operation. Precautions are included to prevent test tones from being placed on the telco lines or on the speech input to the position equipment. Tables 5-3 and 5-4 provide input and output connections for local and remote terminal external signal connections.

c. Test Equipment Required.

(1) Audio oscillator or signal generator.

(2) Transmission test set (TTS).

d. Conditions.

(1) Coordinate a shut down of the channel for maintenance.

(2) Align individual terminals.

(3) Check the local and remote terminal as a system.

e. Detailed Procedure. In many cases line losses at 2820 Hz will be different from losses at 1000 Hz. This difference may require use of the specified initial tolerance/limit levels for optimum equipment performance. The procedures below provide for alignment of the terminals independent of each other, however, end-to-end alignment is desirable to assure proper operation. A voice modulation check should be conducted from the control site after adjustments have been completed.

(1) Local Terminal Transmit. (See figure 5-24.)

(a) Ensure that a terminated plug is inserted into the TRANSMIT AGG EQ jack (J2) to prevent the test tones from being placed on the line.

(b) Using an extender card, plug the line interface module (LIM) into the card cage.

(c) Inject a 1000 Hz test tone into the TRANSMIT SP EQ jack (J1) at the level specified in paragraph 72a(1)(a).

(d) Adjust R2 on the LIM for approximately −10 dBm at the output of U1A.

(e) Adjust TX LEVEL (R5) on the LIM front panel for the level specified in paragraph 72a(1)(b).

(f) Remove the test tone from J1.

(g) On the FSK KEYER module, adjust the front panel TX LEVEL control (R9) for −10 dBm at the output of the 2820 BP filter, FL1.

(h) Adjust R12 on the LIM for the level specified in paragraph 72a(1)(c).

(i) Restore the equipment to normal.

(2) Local Terminal Receive. (See figure 5-25.)

(a) Insert the 1000 Hz test tone into the line interface module RECEIVE AGG EQ jack (J3) at the level specified in paragraph 72a(2)(a).

(b) Adjust RX LEVEL control (R16) on the LIM front panel for approximately −10 dBm signal level at the output of U3A.

(c) Connect a meter (terminated) to the SPEECH RX EQ jack (J4).

(d) Adjust LIM R19 control for the level specified in paragraph 70a(2)(b) at the SPEECH RX jack J4.

(e) Restore the equipment to normal configuration.

(3) Remote Terminal Transmit. (See figure 5-26.)

(a) Insert the test meter plug (terminated) into the VF TX EQ jack (J2).

(b) Connect the 1000 Hz test tone signal to J1, RECEIVE EQ jack (J1) at the level specified in paragraph 72b(1)(a).

(c) Adjust R2 clockwise to approximately three-fourths of its range.

Table 5-3. LOCAL TERMINAL EXTERNAL SIGNAL CONNECTIONS

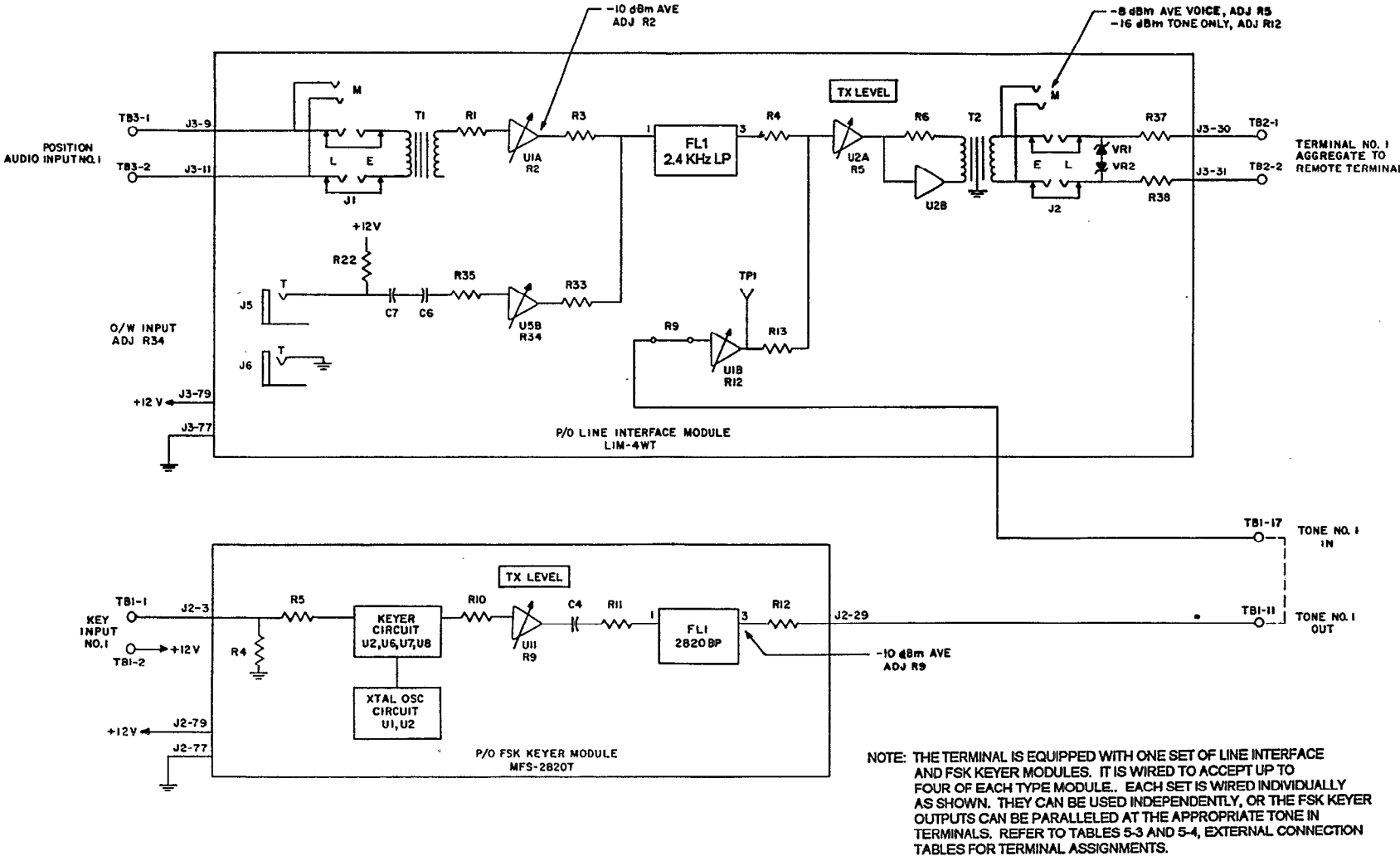
1	Key 1	Term Tx 1	Pos Tx 1	
2	+12 V	Term Tx 1	Pos Tx 1	
3	SG	SG	SG	
4	Key 2	PG	Pos Rx 1	
5	+12 V	Term Rx 1	Pos Rx 1	+12 V
6	Key 3	Term Rx 1	Pos Tx 1	Grd
7	+12 V	Term Tx 2	Pos Tx 2	+12 V
8	SG	Term Tx 2	SG	Grd
9	Key 4	SG	Pos Rx 2	+12 V
10	+12 V	PG	Pos Rx 2	Grd
11	Tone 1 out	Term Tx 2	Pos Tx 3	+12 V
12	SG	Term Rx 2	Pos Tx 3	Grd
13	Tone 2 out	Term Tx 3	SG	
14	Tone 3 out	Term Tx 3	Pos Rx 3	
15	SG	SG	Pos Rx 3	
16	Tone 4 out	PG	Pos Tx 4	
17	Tone 1 out	Term Rx 3	Pos Tx 4	
18	SG	Term Rx 3	SG	
19	Tone 2 in	Term Tx 4	Pos Rx 4	
20	Tone 3 in	Term Tx 4	Pos Rx 4	
21	SG	SG		
22	Tone 4 in	PG		
23		Term Rx 4		
24		Term Rx 4		

SG - Shield Ground
PG - Reserved for Protector Ground
TB4-12 - Should be connected to the facility ground

Table 5-4. REMOTE TERMINAL EXTERNAL SIGNAL CONNECTIONS

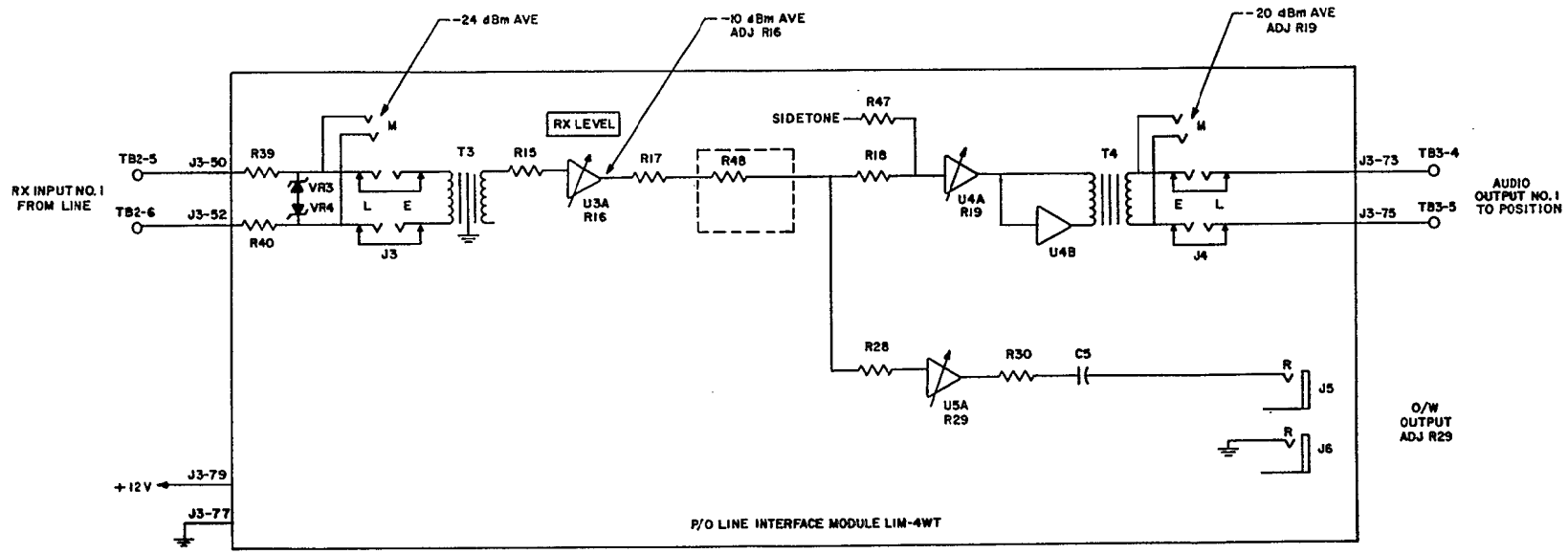
	TB 1	*TB 2*
1	Term Tx	Key NC
2	Term Tx	Key C
3	SG	Key NO
4	PG	SG
5	Term Rx	Agg. out
6	Term Rx	SG
7	SG	
8	Low Tone Alm.	Equip Tx out
9		Equip Tx out
10		SG
11	+12 V	Equip Rx in
12	Grd	Equip Rx in

SG - Shield Ground
PG - Reserved for Protector Ground
TB1-12 - Should be connected to the facility ground



NOTE: THE TERMINAL IS EQUIPPED WITH ONE SET OF LINE INTERFACE AND FSK KEYER MODULES. IT IS WIRED TO ACCEPT UP TO FOUR OF EACH TYPE MODULE.. EACH SET IS WIRED INDIVIDUALLY AS SHOWN. THEY CAN BE USED INDEPENDENTLY, OR THE FSK KEYER OUTPUTS CAN BE PARALLELED AT THE APPROPRIATE TONE IN TERMINALS. REFER TO TABLES 5-3 AND 5-4, EXTERNAL CONNECTION TABLES FOR TERMINAL ASSIGNMENTS.

Figure 5-24. Block Diagram, SFO Local Terminal Transmit Path



NOTE: THE TERMINAL IS EQUIPPED WITH ONE LINE INTERFACE MODULE. IT IS WIRED TO ACCEPT UP TO FOUR. EACH ONE IS WIRED INDIVIDUALLY AS SHOWN. REFER TO TABLES 5-3 AND 5-4, EXTERNAL CONNECTION TABLES FOR TERMINAL ASSIGNMENTS.

Figure 5-25. Block Diagram, SFO Local Terminal Receive Path

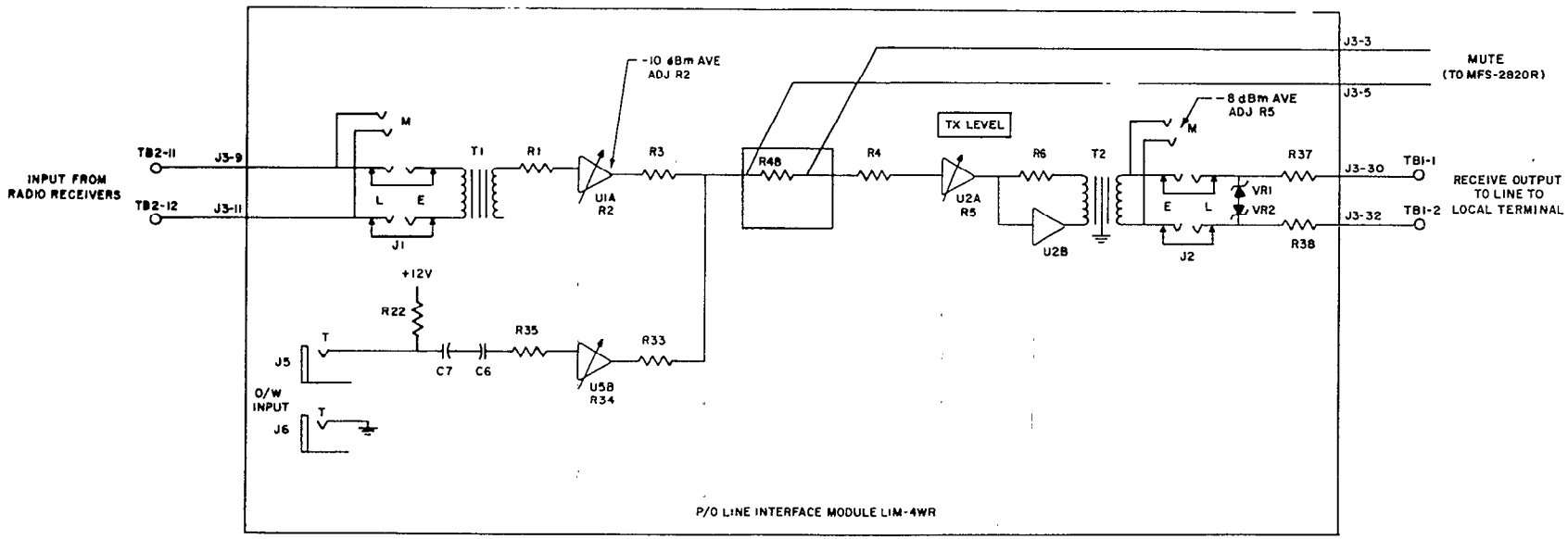


Figure 5-26. Block Diagram, SFO Remote Terminal Transmit Path

(d) Adjust the LIM front panel TX LEVEL control for the level specified in paragraph 72b(1)(b).

(e) Restore the equipment to normal.

(4) Remote Terminal Receive. (See figure 5-27.)

(a) Connect the 1000 Hz test tone signal to the J3 receive EQ jack at the level specified in paragraph 72b(2)(a).

(b) Adjust RX LEVEL (R16) for approximately -10 dBm signal level at the output of U3A. Readjustment to a slightly higher level may be required if the level specified in step (e) below cannot be reached.

(c) With the test meter plug (terminated) in (J4), adjust R19 for the level specified in paragraph 72b(2)(b).

(d) By adjusting R16, temporarily decrease the signal at TP3 to a level 16 dB lower than the level specified in paragraph 72b(2)(c).

(e) Adjust R15 on the FSK keyer so the alarm lamp is fully illuminated.

(f) Readjust R16 on the LIM for the level specified in paragraph 72b(2)(d). The final value for the R16 RX LEVEL should be selected to give an alarm ratio of 16 dB.

(g) Restore the equipment to normal.

* 138. RADIO CONTROL EQUIPMENT AUDIO ADJUSTMENT.

a. **Object.** This procedure describes the usage of the maintenance data terminal (MDT) to align the individual local and remote terminals.

b. **Discussion.** The RCE allows remote users to access and adjust the input and output audio levels at the control and remote RCE through the use of the MDT. The following procedure allows for adjustments from a central location without having personnel available at each site. *

* c. **Test Equipment Required.**

(1) Laptop computer with 80386 or faster processor.

(2) MDT

(3) Serial port cable with DB-9F connectors

(4) TTS-44 or equivalent.

d. **Conditions.**

(1) Coordinate the shutdown of the channel for maintenance.

(2) Align the individual terminals.

(3) Check the local and remote terminal as a system.

e. **Detailed Procedures.** The procedures below provide for alignment of the terminals independent of each other; however, end-to-end alignment is desirable to assure proper operation. A voice modulation check should be conducted from the control site after adjustments have been completed.

NOTE: The procedures use keyboard entries to perform desired actions in lieu of a mouse. Use short-cut keys where possible to accelerate selections. Short-cut keys are accessed by pressing the ALT key and an associated letter key simultaneously (e.g., **ALT-D**). The use and actions of the mouse are similar to any windows application.

NOTE: Required keystrokes will be highlighted with **boldface** type.

(1) Local Terminal. Refer to figure 5-28 for guidance. If maintenance is being accomplished from the remote terminal, proceed to paragraph 138e(2)..

NOTE: All tests must be performed with the input and output circuit disconnected from any active radio circuit. Remove demarc clips, if necessary. *

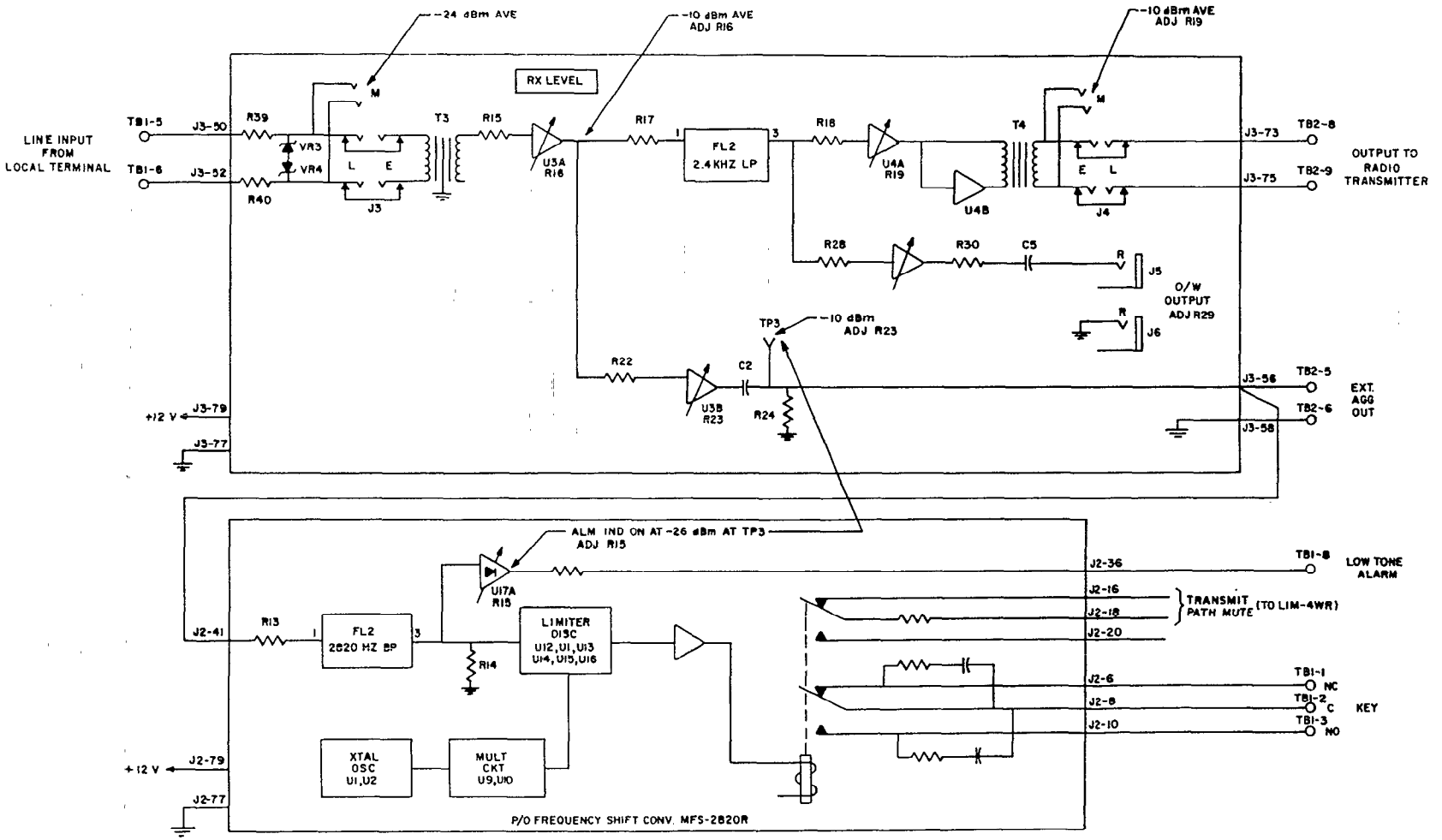


Figure 5-27. Block Diagram, SFO Remote Terminal Receive Path

* (a) Connect the MDT serial cable from the MDT nine-pin serial port to the front panel CMD PORT connector of the C-RCE. Place the CMD PORT SELECT switch in the FRONT position. This takes control of the C-RCE from the CMT.

(b) Turn the computer on. At the DOS prompt, type **cd\rcemdt** to enter the RCE maintenance terminal directory. At the prompt, type **mdt** and press **Enter**.

(c) Enter the password to begin execution of the MDT software.

(d) Press **ALT-M** to access the Maintenance Menu. Highlight MAINTENANCE ENABLE using the down arrow (↓) key and press **Enter** to access the maintenance window.

(e) Depress **TAB** until Maintenance Enable is highlighted. Depress the space bar to select. Press **ALT-S** to execute the SET command. The C-RCE is now in maintenance mode.

(f) Press **ALT-C** to CLOSE the maintenance window.

(g) Set up a TTS-44 for a -5 dBm, 1004 Hz, 600-ohm TERM. Insert the TTS-44 send into the DROP ACCESS LOCAL RX port 1 for frequency 1 (F1) or port 2 for frequency 2 (F2).

(h) Insert the TTS-44 receive side, 600-ohm, TERM, into the DROP ACCESS LOCAL TX port for F1 or F2.

(i) On the front panel of the C-RCE, place the equipment in loopback by inserting a bantam patchcord between the transmit and receive trunk jacks on the DVC circuit card.

(j) On the MDT, press **ALT-D** to access the DVC menu.

(k) Highlight AGC GAIN using down arrow (↓) key and press **Enter**.

(l) Press **ALT-P** to execute the GET POWER function. The power levels into and out of the C-RCE will be displayed. *

* (m) If the power levels are not within the tolerances specified in paragraph 72-1a, retrieve the current gain/attenuation settings by pressing **ALT-G** to execute the GET function.

NOTE: Each depression of the TAB key advances the cursor forward one field in the AGC GAIN display screen. Pressing the SHIFT key and TAB simultaneously, moves the cursor backwards to the previous field.

(n) Depress **TAB** until the TX GAIN or RX GAIN/ AGC field is highlighted for F1 or F2. Set the proper gain or attenuation required for F1 or F2 to achieve the levels specified in paragraphs 72-1a(1)(a) and 72-1a(2)(a).

(o) Depress the **TAB** key until the desired TRUNK 1 (for F1) or TRUNK 2 (for F2) field is highlighted. Set the proper gain or attenuation required for the telco lines to achieve the power levels specified in paragraph 72-1a(1)(b) and 72-1a(2)(b).

NOTE: Adjustment of the TRUNK audio level does not change the modem level.

(p) Depress the **TAB** key until the MODEM 1 or MODEM 2 field is highlighted. Adjust levels for MODEM 1 or MODEM 2 to conform to paragraph 72-1a(1)(c).

NOTE: The modem transmit level is an absolute value and not a gain or attenuation in reference to the TRUNK levels. Example: For a zero loss line transmit level of -8 dBm, the modem level shall be -24 dBm

(q) Press **ALT-S** to execute the SET function. This records the new settings into the RCE equipment.

(r) Press **ALT-P** to verify the settings.

(s) Press **ALT-C** (CLOSE) to exit the AGC GAIN display screen.

(t) Press **ALT-M** to enter the Maintenance Menu. Highlight MAINTENANCE ENABLE and press **Enter**. *

(u) Press **ALT-G** to GET the current settings. Highlight Maintenance Enable by pressing the **TAB** key. Press the spacebar to deselect the maintenance enable.

(v) Press **ALT-S** to SET the new settings. Press **ALT-C** to CLOSE the Maintenance Enable screen.

CAUTION: ALWAYS EXIT THE MDT PROGRAM BEFORE TURNING OFF THE MDT.

(w) Press **ALT-X** to exit the MDT application. Remove all test equipment and reconnect any demarc clips, if necessary. Turn off the MDT and disconnect it from the RCE equipment.

(x) Place the CMD PORT SELECT switch to REAR. This returns monitoring back to the CMT.

(2) Remote Terminal. Refer to figure 5-28 for guidance. If operating from the local terminal (control site), refer to paragraph 138e(1).

NOTE: All tests must be performed with the input and output circuit disconnected from any active radio circuit. Remove demarc clips, if necessary.

(a) Connect the MDT serial cable from the MDT nine-pin serial port to the front panel CMD PORT connector of the R-RCE. Place the CMD PORT SELECT switch in the FRONT position. This takes control of the R-RCE from the CMT.

(b) Turn the computer on. At the DOS prompt, type **cd\rcemdt** to enter the RCE maintenance terminal directory. At the prompt, type **mdt** and press **Enter**.

(c) Enter the password to begin execution of the MDT software.

(d) Press **ALT-M** to access the Maintenance Menu. Highlight MAINTENANCE ENABLE using the down arrow (↓) key and press **Enter** to access the maintenance window. *

(e) Depress **TAB** until Maintenance Enable is highlighted. Depress the space bar to select. Press **ALT-S** to execute the SET command. The R-RCE is now in maintenance mode. *

(f) Press **ALT-C** to CLOSE the maintenance window.

(g) Setup a TTS-44 for the level specified in paragraph 72-1b(1)(a), 1004 Hz, 600-ohm TERM. Insert the TTS-44 send into the DROP ACCESS LOCAL RX port 1 for frequency 1 (F1) or port 2 for frequency 2 (F2).

(h) Insert the TTS-44 receive side, 600-ohm, TERM, into the DROP ACCESS LOCAL TX port for F1 or F2.

(i) On the front panel of the R-RCE, place the equipment in loopback by inserting a bantam patchcord between the transmit and receive trunk jacks on the DVC circuit card.

(j) On the MDT, press **ALT-D** to access the DVC menu.

(k) Highlight AGC GAIN using down arrow (↓) key and press **Enter**.

(l) Press **ALT-P** to execute the GET POWER function. The power levels into and out of the R-RCE will be displayed.

(m) If the power levels are not within the tolerances specified in paragraph 72-1b, retrieve the current gain/attenuation settings by pressing **ALT-G** to execute the GET function.

NOTE: Each depression of the TAB key advances the cursor forward one field in the AGC GAIN display screen. Pressing the SHIFT key and TAB simultaneously, moves the cursor backwards to the previous field.

(n) Depress **TAB** until the TX GAIN or RX GAIN/ AGC field is highlighted for F1 or F2. Set the proper gain or attenuation required for F1 or F2 to achieve the levels specified in paragraphs 72-1b(1)(a) and 72-1b(2)(a). *

* (o) Depress the **TAB** key until the desired TRUNK 1 (for F1) or TRUNK 2 (for F2) field is highlighted. Set the proper gain or attenuation required for the telco lines to achieve the power levels specified in paragraph 72-1b(1)(b) and 72-1b(2)(b).

NOTE: Adjustment of the TRUNK audio level does not change the modem level.

(p) Depress the **TAB** key until the MODEM 1 or MODEM 2 field is highlighted. Adjust levels for MODEM 1 or MODEM 2 to conform to paragraph 72-1b(1)(c).

NOTE: The modem transmit level is an absolute value and not a gain or attenuation in reference to the TRUNK levels. Example: For a zero loss line transmit level of -8 dBm, the modem level shall be -24 dBm.

(q) Press **ALT-S** to execute the SET function. This records the new settings into the RCE equipment.

(r) Press **ALT-P** to verify the settings.

(s) Press **ALT-C** (CLOSE) to exit the AGC GAIN display screen.

(t) Press **ALT-M** to enter the Maintenance Menu. Highlight MAINTENANCE ENABLE and press **Enter**.

(u) Press **ALT-G** to GET the current settings. Highlight Maintenance Enable by pressing the **TAB** key. Press the spacebar to deselect the maintenance enable.

(v) Press **ALT-S** to SET the new settings. Press **ALT-C** to CLOSE the Maintenance Enable screen.

(w) Disconnect all test equipment. Reconnect the demarc clips, if necessary, to restore the radio circuit.

CAUTION: ALWAYS EXIT THE MDT PROGRAM BEFORE TURNING OFF THE MDT. *

* (x) Press **ALT-X** to exit the MDT application. Turn off the MDT and disconnect it from the RCE equipment.

(y) Place the CMD PORT SELECT switch to REAR. This returns monitoring back to the CMT.

139. CENTRALIZED MAINTENANCE TERMINAL (CMT) STATUS LOG.

a. **Object.** (Optional.) This procedure describes the steps necessary to maintain the centralized maintenance terminal (CMT) status log. If the log will not be maintained as an archive, the data may be deleted from the database.

b. **Discussion.** The status window on the CMT displays all actions of the CMT and RCE. All log on/off, level change, status change, and communication errors are displayed on the status window and saved to the status log. After 300 events have been added, the system will automatically clear the list box in order to add new messages. All prior events are stored in the status log which may be viewed through the Maintenance Menu. When data is saved to the status log, previous data is not purged; instead the current data is added to the existing file. Without proper maintenance this file will become unmanageable. CMT status records should be archived on a periodic schedule to maintain a manageable database. Archiving is a means to store historical records of past events.

c. **Detailed Procedures.** The procedure below provides for the management of the status log. This procedure should be accomplished on a regular schedule to prevent the database from reaching an unmanageable size.

(1) Exit out of the CMT application to the Program Manager window. Restore the MSOFFICE icon. Highlight the Access program and press **Enter**.

(2) Press **ALT-F** to access the File Menu. Highlight Open Database and press **Enter**.

(3) Change directory to RCE3.

(4) Highlight or type the filename DB1.MDB. Press **Enter**. *

* **NOTE**: If the status log will not be kept on archive, proceed to step (7).

(5) Using the TAB key, highlight the LOGS Archive table. Do not enter the file at this time. Press **ALT-E** to access the Edit Menu. Select COPY.

(6) From the File Menu, highlight New Database and press **Enter**. Enter a logical name for the site archived database (i.e. ZTLRCE1.MDB or ZKCRCE1.MDB). When the new database is opened, select PASTE from the Edit Menu. This will insert the table copied from the DB1.MDB file. Repeat steps (2) through (5) for the LOGS table.

NOTE: The LOGS table is the current status log that is represented in the CMT application QUERY window.

(7) Reopen the DB1.MDB file. Highlight LOGS Archive and press **Enter**. Press **ALT-E** to enter the Edit Menu. Highlight SELECT ALL RECORDS and press **Enter**. Press **Delete** on the keyboard. The archive file will empty.

(8) Repeat step (7) for the LOGS table.

CAUTION: Do not erase the LOGS Archive or LOGS table from the database file. An error * will result which requires the CMT application to be reloaded.

(9) Press **ALT F** to enter the File Menu. Highlight EXIT and press **Enter** to exit the Access database. If the data in the file was deleted, proceed to step (14).

(10) Close out all windows applications and exit to DOS.

(11) At the DOS prompt, type **cd\rce3** to enter the CMT directory.

(12) Search for the file which was created in step (5) above. This is the historical status log file.

(13) Archive the file by performing a backup using the DOS command MSBACKUP.EXE. Store the file on a floppy disk for future reference.

CAUTION: Do not erase or remove the DB1.MDB file or any of its contents from this directory. The CMT application software will not run without this file or its contents.

(14) Reenter the windows directory by typing **win**. Enter the CMT window and activate the application software. *

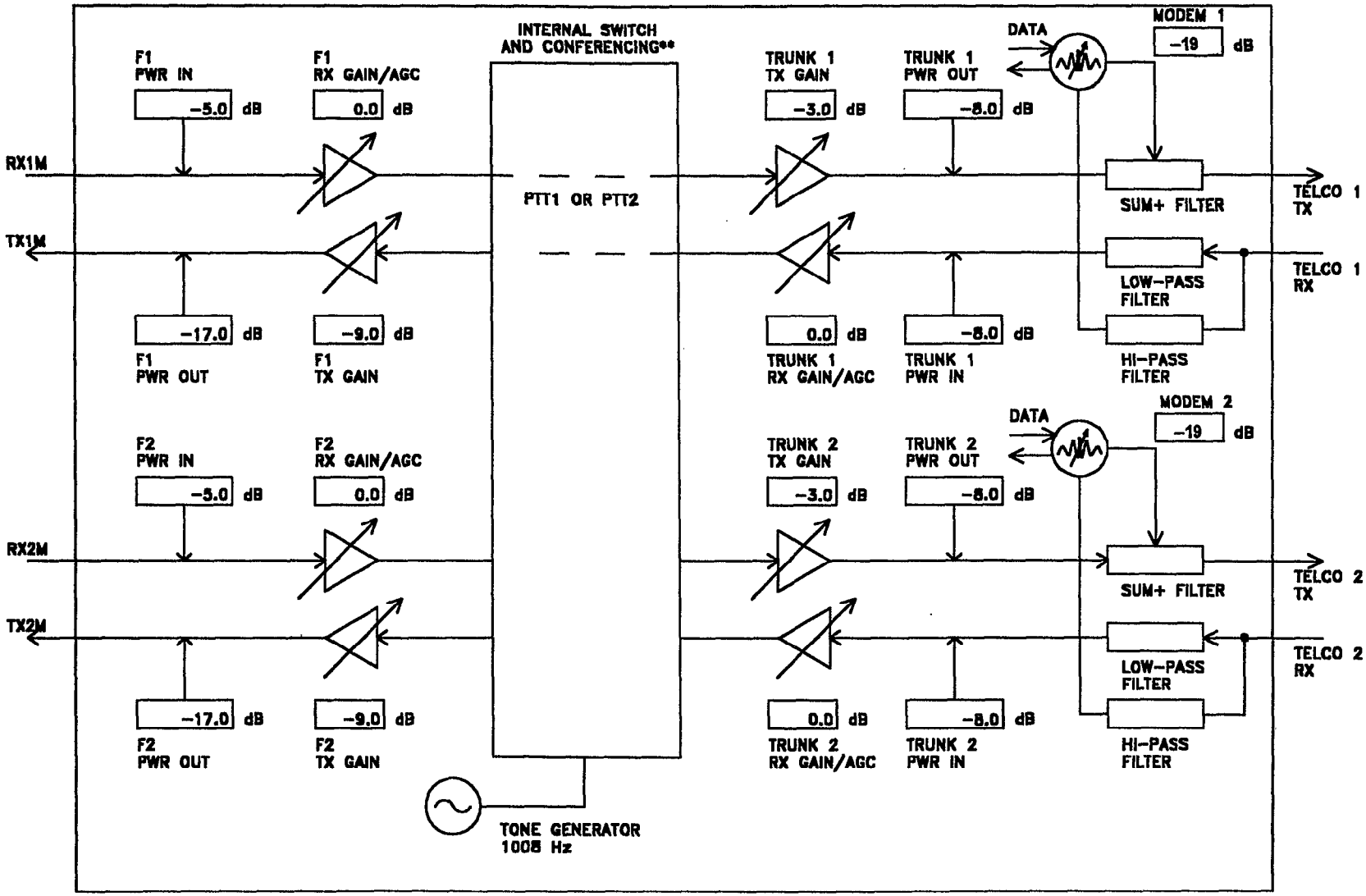


Figure 5-28. Block Diagram, RCE Signal Flow

CHAPTER 6. FLIGHT INSPECTION

140. GENERAL.

Remote control equipment is included in flight inspections to the extent that voice communications must be clearly audible and free from interference and that operating personnel must be able to dial up and switch equipment. Monitor circuits must accurately convey the operating conditions of the remote facility. These functions shall be checked and necessary adjustments accomplished prior to flight checks.

141.-149. RESERVED.

APPENDIX 1. REFERENCE DATA, AUDIO FREQUENCY MEASUREMENTS

1. GENERAL.

This appendix provides graphs and a table for assisting in the calculations required to measure and evaluate audio frequency (af) parameters.

2. DB-VU-DBM UNIT CONVERSION.

Figure 1 is a graph that is useful in converting from one audio unit of value to another. It provides both 1-milliwatt and 6-milliwatt reference scales and a scale of volts root-mean-square (rms) across a 600-ohm impedance.

3. RMS VOLTS TO POWER LEVEL CONVERSION.

Figure 2 is a graph of volts rms to power in dBm across various load impedances. Power levels may be computed by:

$$PdBm = 10\ Log_{10}\ \frac{Erms^2}{0.001R}$$

Where R = resistive impedance of circuit.

4. METER CORRECTION GRAPH.

Figure 3 is a graph depicting correction of meter readings made with the same meter across various resistive load impedances.

5. DECIBELS ABOVE AND BELOW A 1-MILLIWATT REFERENCE LEVEL.

Table 1 is a table of numerical data, accurate up to five significant figures, relating dB, volts rms, and dBm referred to 1 milliwatt in 600 ohms.

6. CONVERSION OF NOISE UNITS.

Figures 4 and 5 are nomographs depicting the conversion of noise readings from one noise meter to another of a different noise-weighting characteristic. Conversions are possible between flat (3 kHz) noise, FIA weighting, 144 weighting, and C-message weighting in dBm, dBa, dBRN, and dBRNC units.

Table 1. DECIBELS ABOVE AND BELOW A REFERENCE LEVEL OF 1 mW INTO 600 OHMS

dB Down		*Level*	*dB Up*	
Volts	*Milliwatts*	*dBm*	*Volts*	*Milliwatts*
0.774 6	1.000	-0+	0.774 6	1.000
0.690 5	0.794 3	1	0.867 1	1.259
0.616 7	0.631 0	2	0.975 2	1.585
0.548 4	0.501 2	3	1.094	1.995
0.488 7	0.398 1	4	1.228	2.512
0.435 6	0.316 2	5	1.377	3.162
0.388 2	0.251 2	6	1.546	3.981
0.346 0	0.199 5	7	1.734	5.012
0.308 4	0.158 5	8	1.946	6.310
0.274 8	0.125 9	9	2.183	7.943
0.244 9	0.100 0	10	2.449	10.000
0.218 3	0.079 43	11	2.748	12.59
0.194 6	0.063 10	12	3.084	15.85
0.173 4	0.050 12	13	3.460	19.95
0.154 6	0.039 81	14	3.882	25.12
0.137 7	0.031 62	15	4.356	31.62
0.122 8	0.025 12	16	4.887	39.81
0.109 4	0.019 95	17	5.484	50.12
0.097 52	0.015 85	18	6.153	63.10
0.086 91	0.012 59	19	6.905	79.43
0.077 46	0.010 00	20	7.746	100.00
0.043 56	0.003 16	25	13.77	316.2
0.024 49	0.001 00	30	24.49	1.000 W
0.013 77	0.000 316	35	43.56	3.162 W
0.007 746	0.000 100	40	77.46	10.00 W
0.004 356	3.16×10^{-5}	45	137.7	31.62 W
0.002 449	1.00×10^{-5}	50	244.9	100 W
0.001 377	3.16×10^{-6}	55	435.6	316.2 W
0.000 774 6	1.00×10^{-6}	60	774.6	1 000 W
0.000 435 6	3.16×10^{-7}	65	1 377	3 162 W
0.000 244 9	1.00×10^{-7}	70	2 449	10 000 W
0.000 137 7	3.16×10^{-8}	75	4 356	31 620 W
0.000 077 46	1.00×10^{-8}	80	7 746	100 000 W

NOTE: The power holds for any impedance, but the voltage holds only for 600 ohms.

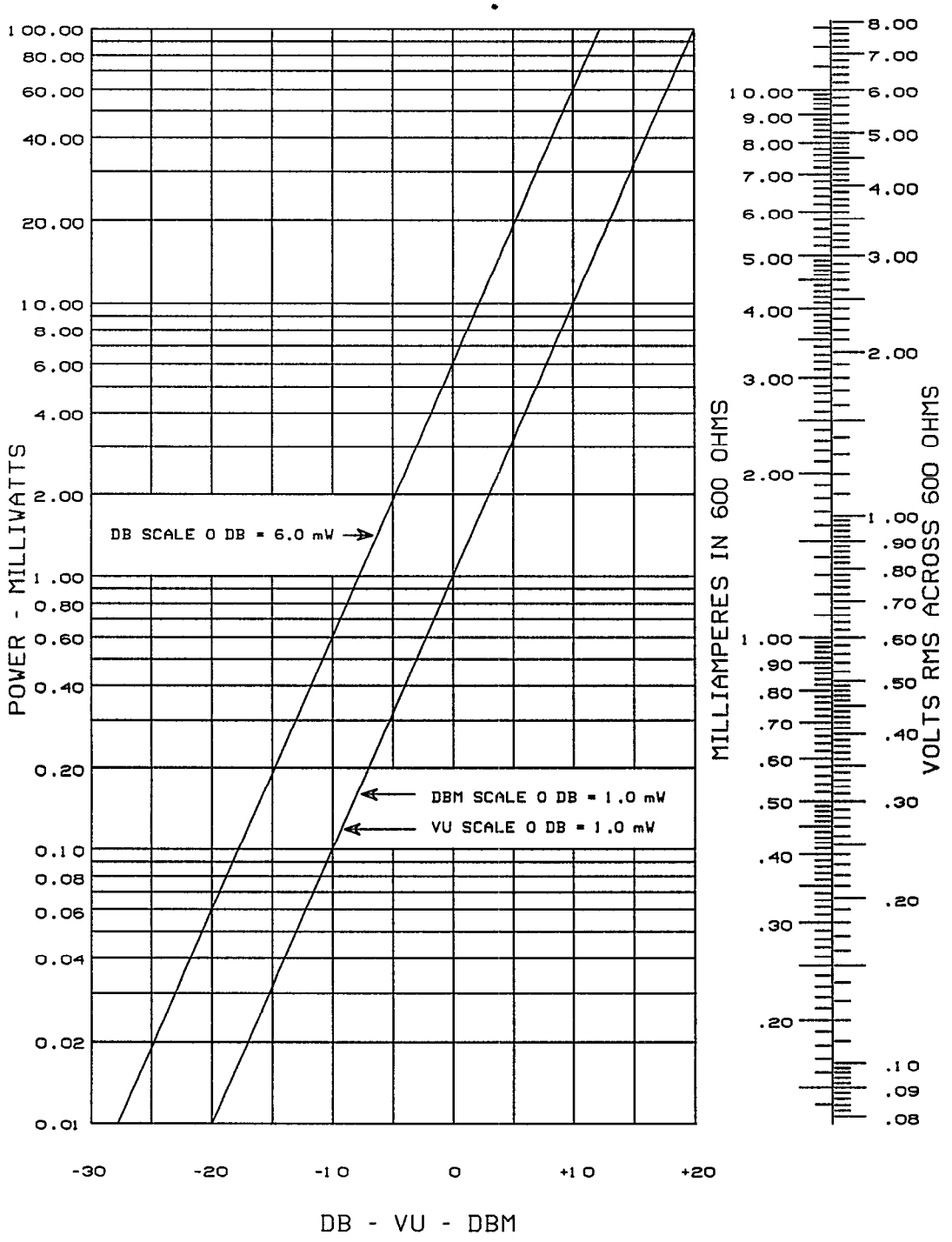


Figure 1. DB-VU-DBM Unit Conversion

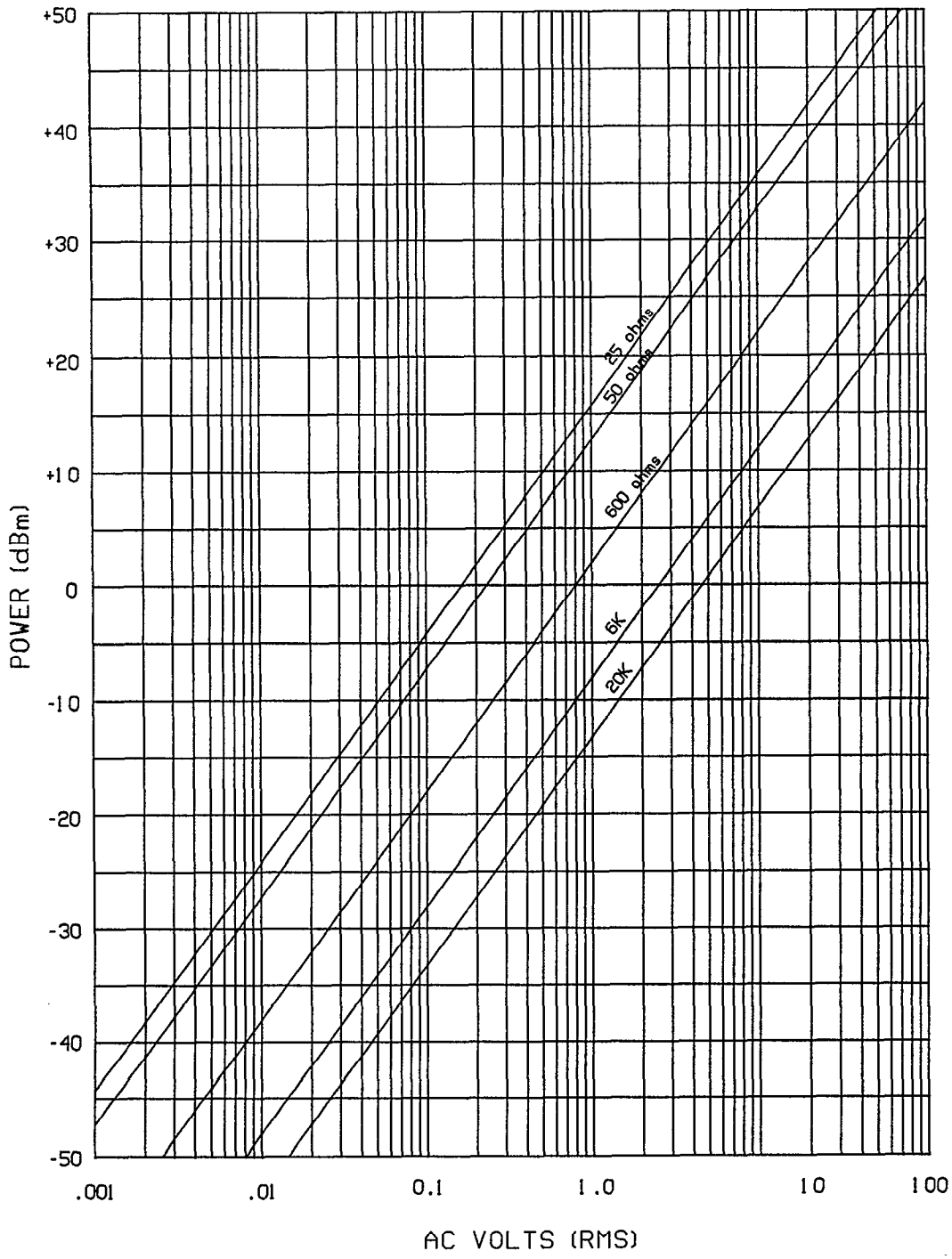


Figure 2. RMS Voltage to Power Level Conversion

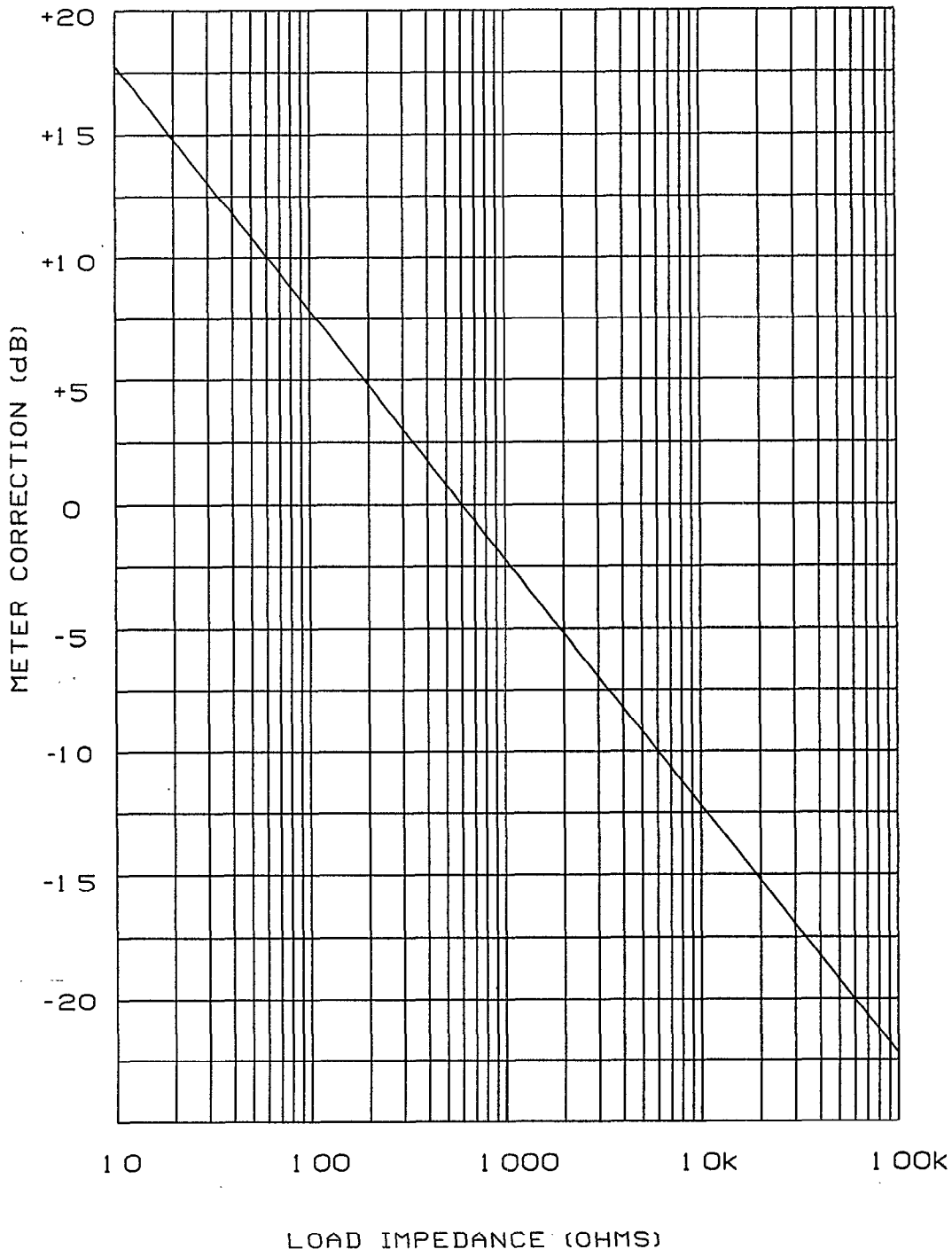


Figure 3. Meter Correction Graph

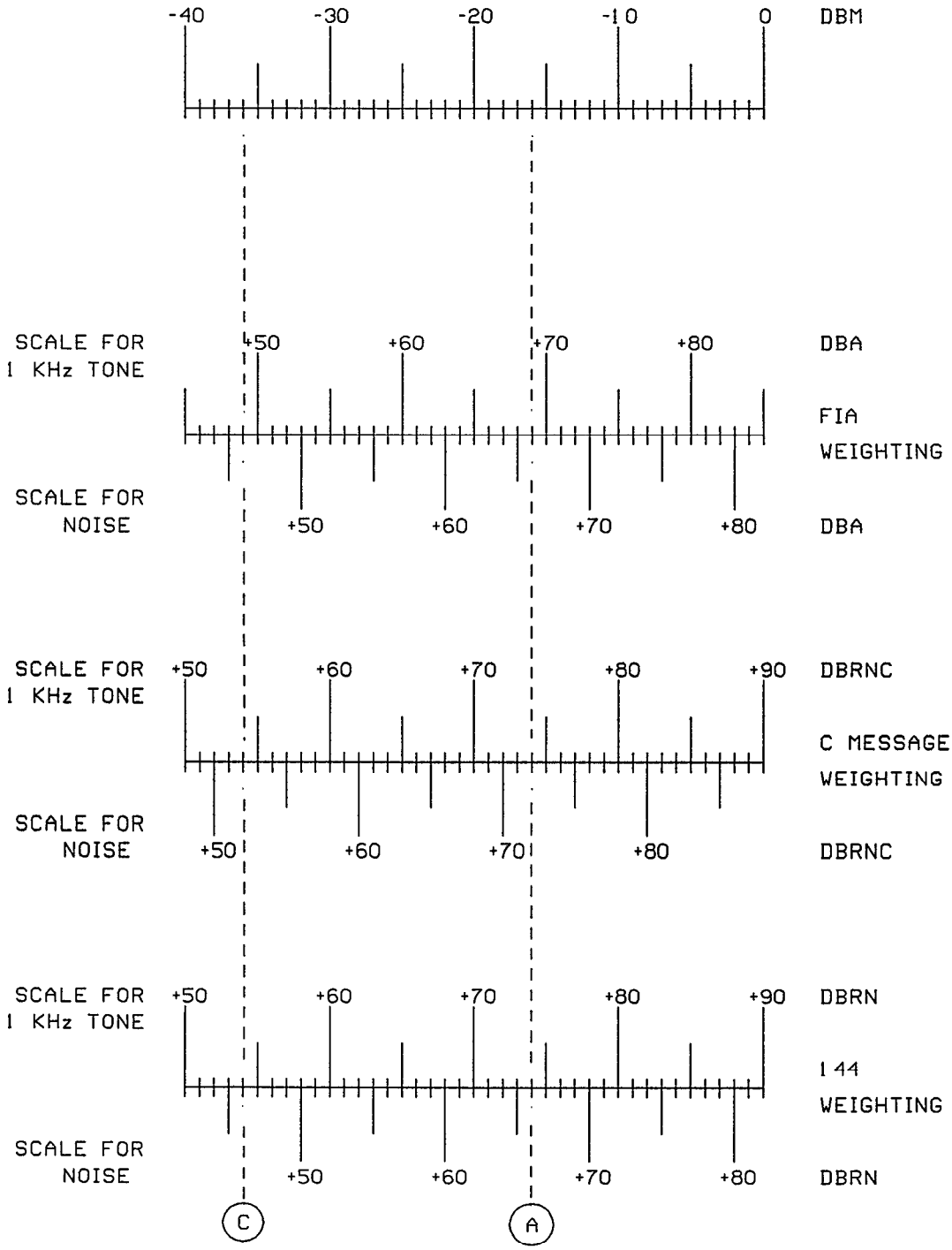


Figure 4. Nomograph for Conversion of Noise Units, 0 to -40 dBm

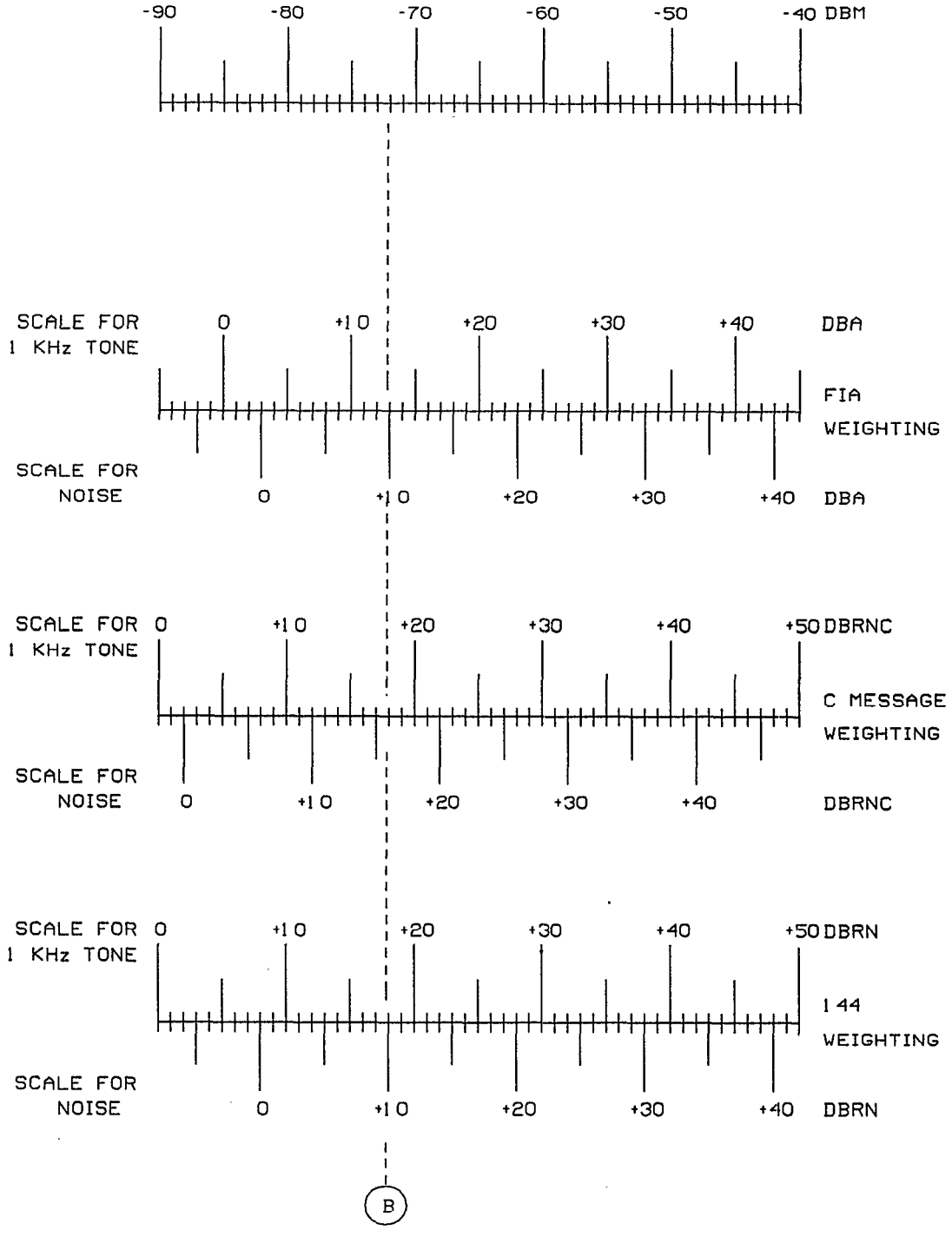


Figure 5. Nomograph for Conversion of Noise Units, -40 to -90 dBm

U.S. Department of Transportation
Federal Aviation Administration

Memorandum

Subject: INFORMATION: Suggested improvements to Order 6650.4D, Maintenance of Voice-Frequency Signaling System (VFSS) Equipment

Date:

From: _____
Signature and Title

Reply to Attn of _____
Facility Identifier
AF Address

To: Manager, National Airway Systems Engineering Division, AOS-200

Problems with present handbook.

Recommended improvements.

*U.S. GOVERNMENT PRINTING OFFICE:1994-568-016/34